102645

THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LX. No. 1521.] LONDON, JULY 5, 1892. [44TH YEAR. PRICE 6d.

WOLSTON'S Paste and Ready Mixed for Use.
Guaranteed Free from Adulteration. **TORBAY PAINTS.**
FOR GASHOLDERS, &c., &c.
The Original "Torbay Paints"
As supplied during the present and many preceding years to the LONDON GASLIGHT & COKE COMPANY.
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Parker's Imperial Black Varnish,
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WORKS:
ORMSIDE STREET, OLD KENT ROAD, LONDON.

Ashmore, Benson, Pease, & Co., Ld.,
STOCKTON-ON-TEES,
Manufacturing Gas Engineers.
See Advt. p. 45.

Lanemark Coal Co.,
LIMITED.
LANEMARK CANNEL AND GAS COALS.
Quotations and Analysis on application to
LANEMARK COLLIERY,
NEW CUMNOCK, N.B.
Shipping Ports: All the principal Scotch Ports.

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"ABYSSINIAN" & ARTESIAN TUBE WELLS,
FOR TOWN WATER-WORKS AND OTHER SUPPLIES.
The following Town Water-Works Supplies have been obtained by this System, viz.:—Abbott's Langley, Aldershot, Alnwick, Cirencester, Hertford, Lechlade, St. Albans, Shrewsbury, Skegness, Southampton, Stony Stratford, Swansea, Wallingford, Watford, West Worthing, Wimborne, &c.
LE GRAND & SUTCLIFF,
HYDRAULIC ENGINEERS, 100, BUNHILL ROW, LONDON, E.C.

SELF-CONTAINED DUST-FUEL FURNACE.
MELDRUM'S PATENT.

Extract from the *Smethwick Telephone,* June 13, 1891.

GAS COMMITTEE.

"The Manager [B. W. Smith, Esq.] reported that the adoption of MELDRUM'S PATENT FURNACES, he estimated, had resulted in a saving of 150 tons of Slack during the nine months they had been at work in the Boiler-House, and 360 tons of Slack during four months in the Retort-House; the fuel used in place of slack being the fine coke dust which formerly had to be carted or boated away at considerable expense."

MELDRUM BROS., Engineers,
ATLANTIC WORKS, 13, CITY ROAD, MANCHESTER.

DANIEL HOWARD,

(Successor to the late BENJ. WHITEHOUSE),

GASHOLDER & BOILER WORKS,

WEST BROMWICH, NEAR BIRMINGHAM

(ESTABLISHED 1765),

MANUFACTURER OF TELESCOPIC AND SINGLE GASHOLDERS,

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PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, and all kinds of GAS APPARATUS,

Wrought-Iron Roofs, Bridges, Girders, &c.,

Steam, Hot Water, and Range Boilers, Tanks, Cisterns, Boats, and all kinds of Wrought-Iron Work.

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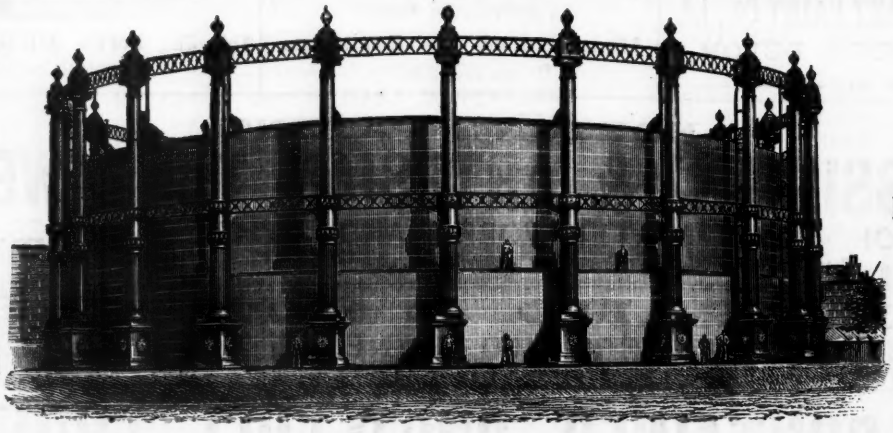


Manufacturers of PATENT WASHERS, PATENT VALVES for PURIFIERS, &c., GOVERNORS, LAMP COLUMNS, Weighbridges, COKE BREAKERS.

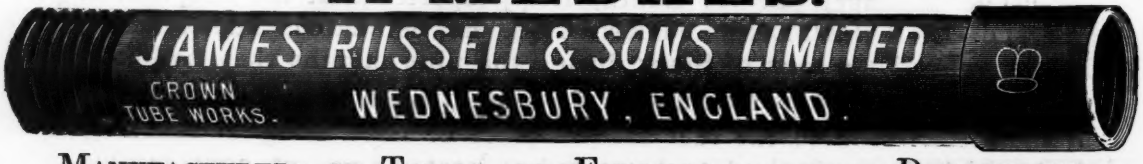
SOLE MAKERS OF COCKEY AND SMITH'S PATENT SELF-ACTING BYE-PASS VALVES.

Estimates for any description of Gas Plant on application.

THE IRON-WORKS, FROME SELWOOD, SOMERSET.

HIGHEST AWARDS—LONDON, PARIS, COLOGNE, VIENNA, MELBOURNE, AND OTHERS.

—11 MEDALS.—



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LONDON OFFICE: 6T. THOMAS APOSTLE, E.C.

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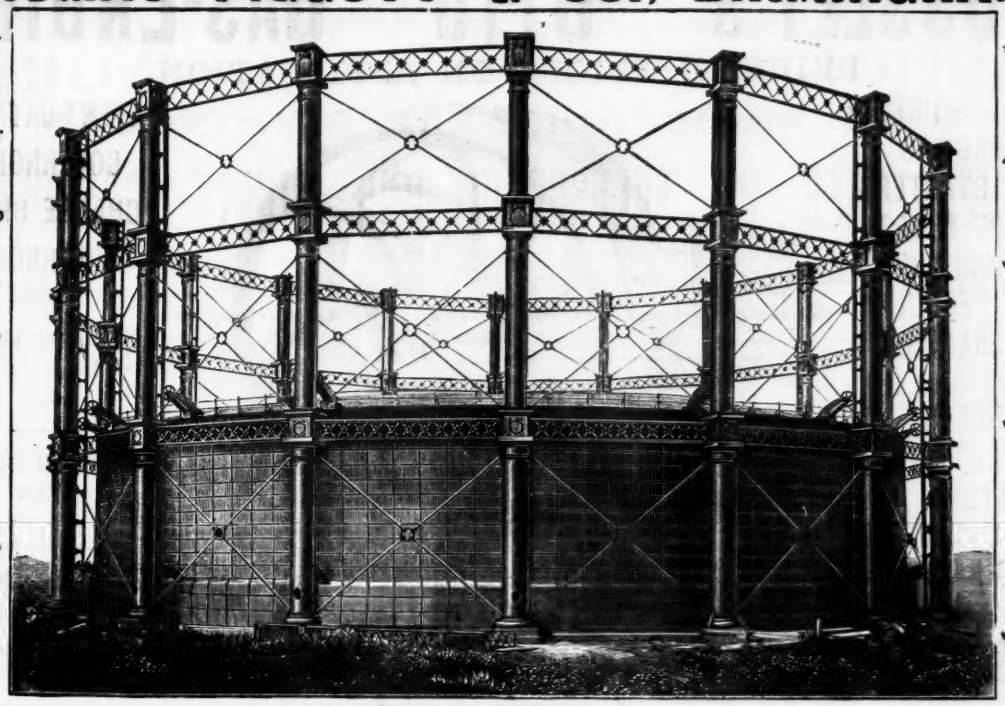

TELEGRAPHIC ADDRESS: ATLAS, BIRMINGHAM.

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Address THE STRAFFORD COLLIERIES COMPANY,

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AND
Gasholder Tanks.

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RETORT-BED FITTINGS,
And Retort-House Appliances
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CONDENSERS,
SCRUBBERS, & WASHERS,
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CENTRE VALVES
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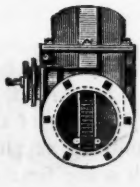
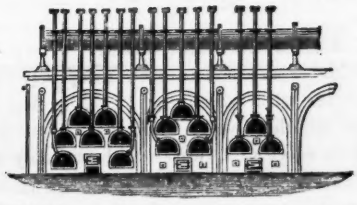
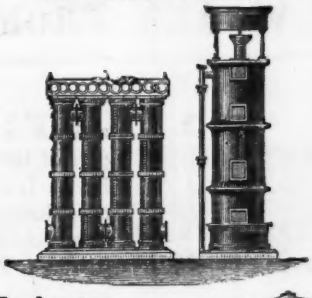
Also Bye-Pass & Stop Valves.







PURIFIERS with Planed Joints,
HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS and SPECIALS,
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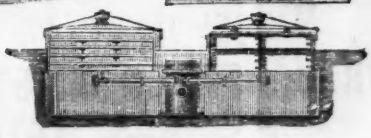
CAST AND WROUGHT IRON TANKS AND CISTERNS.



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Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

GAS COAL FAMOUS FOR ITS UNRIVALLED EXCELLENCE.

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REDUCED PRICES ON APPLICATION.

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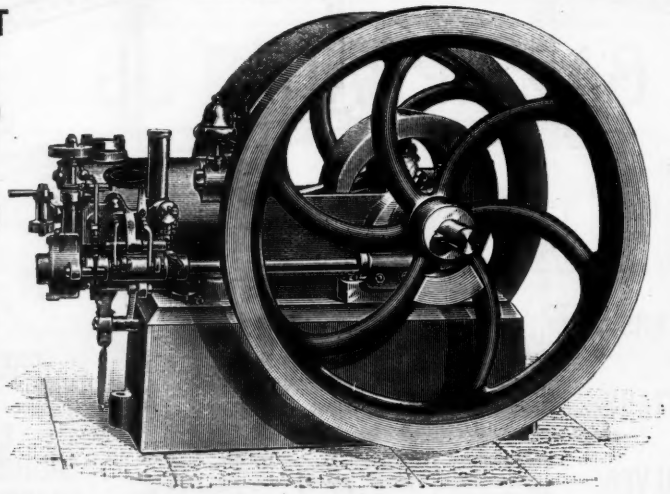

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Every Engine thoroughly tested before being sent out.

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CROSSLEY'S NEW HIGH-SPEED ENGINE FOR DIRECT ELECTRIC LIGHTING.

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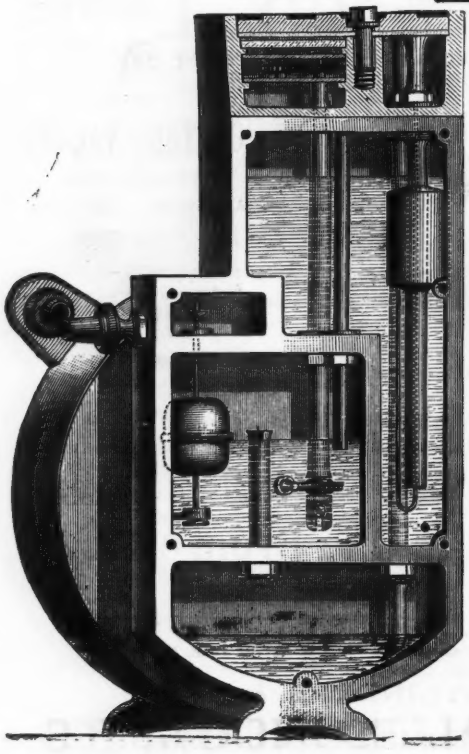
GLAZED BRICKS AND PORCELAIN BATHS.

ALDER AND MACKAY,

MANUFACTURERS OF

IMPROVED WET AND DRY GAS-METERS

IN CAST-IRON AND TIN CASES OF THE HIGHEST EXCELLENCE.



Sole Makers of Green's Patent Underground Wet Gas-Meters for Street Lighting, &c., and Ogden's Patent Spindle Tube for Wet Gas-Meters.

GREEN'S PATENT UNDERGROUND METER

Has been designed to obviate that which has hitherto prevented the general adoption of underground Meters—namely, their serious cost. No box is required, and the saving thus effected as compared with ordinary underground Meters, where either a box or meter-pillar is necessary, is fully one-half. The price of one for three lights is 28s., and the other sizes are correspondingly cheap. When fixed, the only part of the Meter exposed to view measures 6½ inches by 8½ inches. By the Indicator with which the Meter is fitted, the Inspector can at once discern whether water is required; but as the Meter is of the compensating description, water will probably need only be supplied ONCE A YEAR. It is advisable to fill the Meter with a non-freezing liquid, which does not injure the fittings; and this can be supplied at about 1s. per gallon.

Prices and all Information on Application.

NEW GRANGE WORKS, EDINBURGH.

HIGHEST AWARDS given for our WET and DRY METERS at

Exhibitions held at GLASGOW, CALCUTTA, and EDINBURGH.

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GAS AND WATER ENGINEERS.

Manufacturers of **GAS APPARATUS** of every Description.

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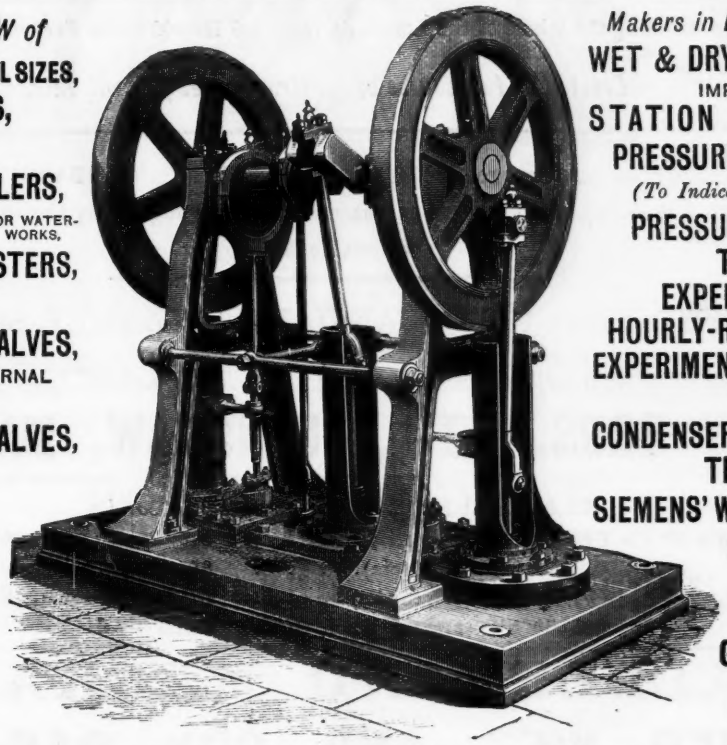
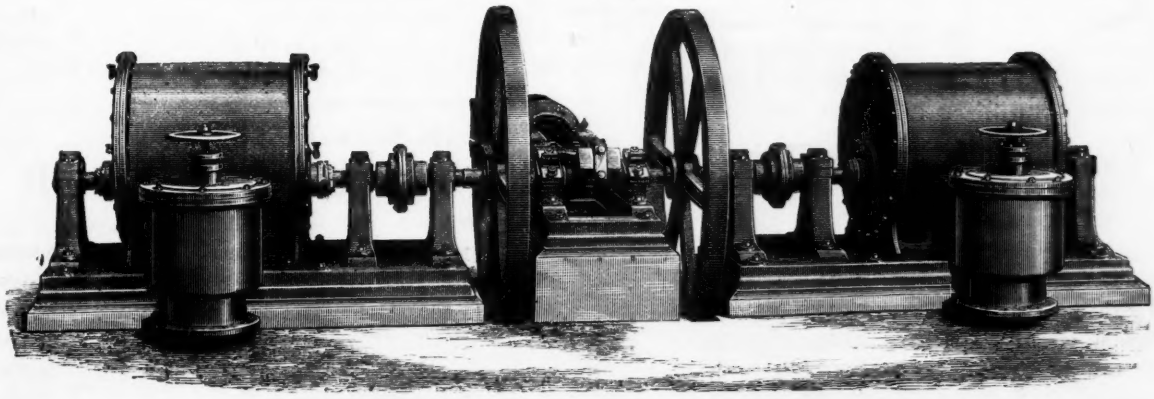
CAST-IRON PIPES, ALL SIZES,
LAMP PILLARS,
STEAM-ENGINES AND BOILERS,
PUMPING ENGINES FOR WATER-WORKS,
BEALE'S GAS EXHAUSTERS,
DOUBLE-FACED SLUICE VALVES,
INTERNAL AND EXTERNAL RACK OR SCREW SLIDE VALVES,
CAST-IRON COLUMNS,
BEAMS, GIRDERS, AND WATER-TANKS,
WROUGHT-IRON TUBES, & FITTINGS, &c.



Makers in EDINBURGH of

WET & DRY GAS-METERS,
IMPROVED STATION GOVERNORS,
PRESSURE REGISTERS *(To Indicate New Time)*,
PRESSURE GAUGES,
TEST HOLDERS,
EXPERIMENTAL HOURLY-RATE METERS,
EXPERIMENTAL TEST METERS,
CONDENSER THERMOMETERS,
SIEMENS' WATER-METERS,
STREET LANTERNS,
And all Kinds of GAS APPARATUS AND FITTINGS, &c.

PUMPING GAS EXHAUSTER AND ENGINE COMBINED. All Sizes.



BEALE'S GAS EXHAUSTERS AND ENGINE COMBINED. All Sizes.

Prices, with full Particulars, will be given on application.

Two Gold Medals, One Silver Medal, One Bronze Medal, and Two Honourable Mentions,

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ALLIANCE FOUNDRY, **GLASGOW.** | SIMON SQUARE WORKS, **EDINBURGH.** | 6, LITTLE BUSH LANE, **LONDON, E.C.**

KIRKHAM, HULETT, & CHANDLER, LIMITED.

[SIDNEY HERSEY, Managing Director.] [J. CHANDLER, Engineer.]

449 Patent "Standard" Washer-Scrubbers,

Capable of extracting the whole of the Ammonia from 426,560,000 Cubic Feet of Gas per 24 hours,

Erected and in course of construction at present date.

The following List comprises the orders received for Improved PATENT "STANDARD" WASHER-SCRUBBERS constructed according to the Company's latest patent, and Renewals effected by the application of same to old pattern Machines.

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,,	3,500,000	Colchester	1,000,000	Workington	500,000
Kensal Green	3,000,000	Cambridge	1,000,000	Lowestoft	500,000
,,	3,000,000	West Bromwich	1,000,000	Newton-le-Willows	500,000
Liverpool	3,000,000	Luton	1,000,000	Manchester	400,000
,,	3,000,000	Alger (Algieria)	875,000	Erfurt (Germany)	400,000
Croydon	3,000,000	Valencia (Spain)	875,000	St. Chamond (France)	350,000
West Ham	3,000,000	Barcelona (Spain)	875,000	Santander (Spain)	350,000
Rochdale	3,000,000	Nice (France)	875,000	Atlas Steel Works, Sheffield	250,000
Paris	3,000,000	Stockport	800,000	Bangor	250,000
,,	3,000,000	Magdeburg (Germany)	750,000	Lille (France)	250,000
Glasgow	2,500,000	Altoona (U.S.A.)	750,000	Melun ,,	210,000
,,	2,500,000	Smethwick	750,000	Valencia (Spain)	200,000
Manchester	2,500,000	Schneider-Creusot Works		,, ,,	200,000
Leicester	2,250,000	(France)	735,000	Vercelli (Italy)	200,000
Swansea	2,000,000	Valparaiso (Chili)	600,000	Rawmarsh	200,000
Bordeaux	2,000,000	Halle (Germany)	600,000	Baccarat (France)	175,000
Melbourne	1,500,000	Elberfeld ,,	600,000	Hitchin	150,000
Charlottenburg (Germany)	1,500,000	,, ,,	600,000	Sydney	100,000
Derby	1,500,000	Nancy (France)	525,000	Balson-Chateauroux (France)	70,000
,,	1,000,000	,, ,,	525,000		

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Birmingham	5,000,000	Hastings	1,500,000	Heckmondwike	500,000
Nine Elms (in part)	3,000,000	West Ham	1,500,000	Hampton Wick	500,000
Vauxhall ,,	3,000,000	Nottingham	1,500,000	Kingston-on-Hull	400,000
Dublin	3,000,000	Melbourne	1,500,000	Weston-super-Mare (in part)	400,000
Shoreditch (in part)	2,500,000	,,	1,500,000	Enfield	300,000
Beckton	2,500,000	Crewe (L. & N.W.R. Co.)	1,250,000	Harrow	250,000
Manchester	2,500,000	Beckton	1,250,000	Buxton	250,000
Bromley	2,000,000	,, (in part)	1,250,000	Quebec, Canada (in part)	250,000
Pimlico (in part)	2,000,000	Bradford	1,250,000	Newmarket	150,000
Plymouth	2,000,000	Maidstone	1,000,000	Leominster	150,000
Croydon	1,500,000	Smethwick	750,000	Kidsgrove	100,000
Edinburgh	1,500,000	Heywood	600,000		

All New Patent "Standard" Washer-Scrubbers are fitted with the Company's Patent Improved Wooden "Bundles" or Washing Devices, which can be readily fitted to old pattern Machines.

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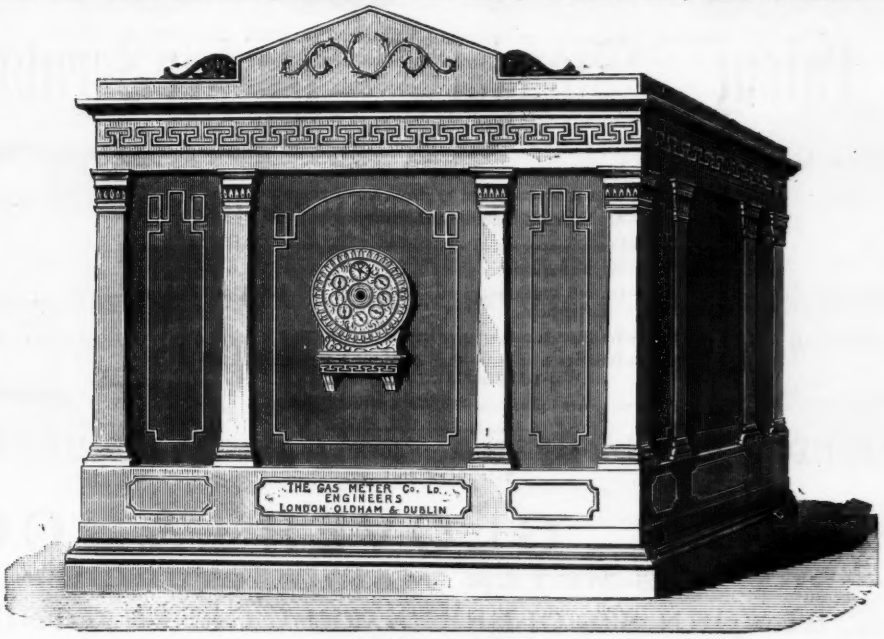
WET AND DRY GAS-METERS, STATION METERS, GOVERNORS, GAS APPARATUS, ETC.

SQUARE STATION METERS WITH PLANED JOINTS.



STATION METERS IN CYLINDRICAL CASES.

DESIGN No. 2 PATTERN.

STATION METERS MADE AT THE COMPANY'S WORKS, OLDHAM, LATE WEST & GREGSON, **Established 1830.**

For Prices and Particulars apply to

R. L. ANDREWS, General Manager.

Works: 238, KINGSLAND ROAD, LONDON; UNION STREET, OLDHAM; HANOVER STREET, DUBLIN.

Telegraphic Address: "METER."

[See Advertisement on back of Wrapper.

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SOLE MAKERS:

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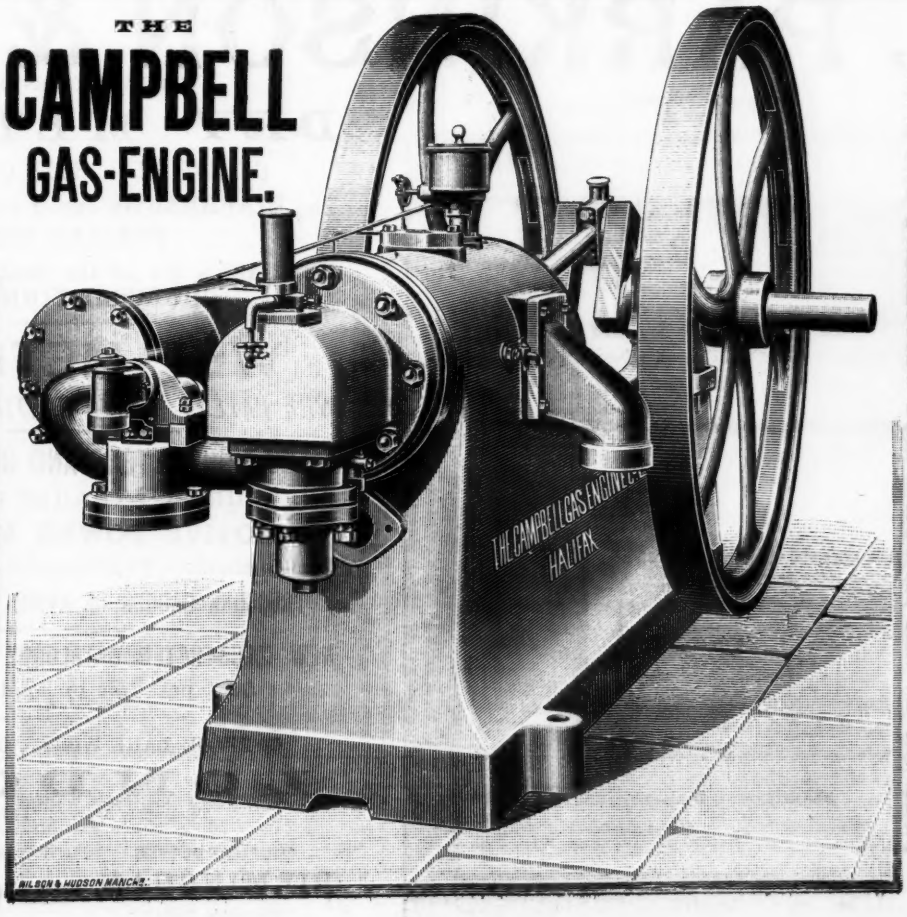
LONDON: 114, TOOLEY ST. GLASGOW: 99, BOTHWELL ST. BIRMINGHAM: 103, SNOW HILL

THE SIMPLEST GAS-ENGINE MADE.



SUPPLIED TO HER MAJESTY'S WAR DEPARTMENT AND MANY GAS-WORKS.

GAS CONSUMPTION AND POWER DEVELOPED GUARANTEED.

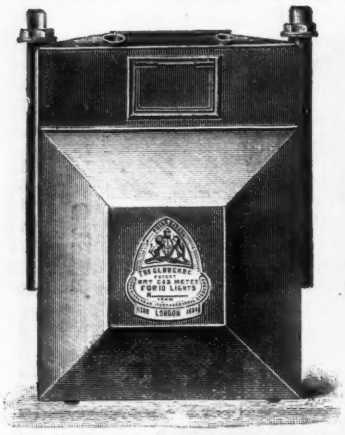
PATENT STARTERS. PATENT GOVERNORS.

THE SECOND LARGEST GAS-ENGINE MAKERS IN THE KINGDOM.

[ESTABLISHED 1844.] **ORIGINAL MAKERS.** [ESTABLISHED 1844.]

LONDON, 1851. NEW YORK, 1853. PARIS, 1855. LONDON, 1862. DUBLIN, 1865. PARIS, 1867.

THE SIX MEDALS AWARDED TO THOMAS GLOVER'S PATENT DRY GAS-METERS;
The latter being the Highest Award for Dry Gas-Meters at the Paris Exhibition, 1867. Since then we have not Exhibited FOR PRIZES.



1st.—Are a remedy for all the defects of Wet Meters.
2nd.—Are suitable for all Climates, whether hot or cold.
3rd.—Incur no loss of Gas by Evaporation.
4th.—Cannot become fixed by Frost, however severe.
5th.—Are the most accurate and unvarying measurers of Gas.
6th.—Prevent jumping or unexpected extinction of the Lights.
7th.—May be fixed either above or below the level of the Lights.
8th.—Cannot be tampered with without visibly damaging the outer case.
9th.—Will last much longer than Wet Meters.
10th.—Will not cost more than one-half for repair that Wet or Water Meters do.

Are upheld for five years without charge.

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LEEDS: BOAR LANE CHAMBERS, 4, BASINGHALL STREET. *Telegraphic Address: "GOTHIC."*

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OF THE VERY BEST QUALITY.

The DIAPHRAGMS are of the Finest PERSIAN SHEEP SKINS.

The CASES are of the Best CHARCOAL-TINNED PLATES.

WET METERS,

With PATENT THREE-PARTITION DRUMS.

STATION METERS AND GOVERNORS,
PRESSURE & EXHAUST REGISTERS,
MOTIVE POWER METERS,
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PRESSURE GAUGES OF EVERY DESCRIPTION.

NEW ILLUSTRATED CATALOGUE & PRICE LIST
Sent post free on application.

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LONDON.
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OFFICE: 10, MAWSON'S CHAMBERS, DEANSGATE, **MANCHESTER.** Telegraphic Address: "PRECISION."

CONTENTS.

EDITORIAL NOTES:—

GAS, LIGHTING, &c.— PAGE

The Address of the President of the French Gas Managers 9
Commercial Principles and State Laws 10
Municipalism in Manchester and Salford 10
A Political Assault upon the Patent Law 10
Another Smoke Abatement Illusion 11

WATER AND SANITARY AFFAIRS—

The Royal Commission on Water Supply—Further Evidence for the County Council 11

THE INCORPORATED GAS INSTITUTE:—

PROCEEDINGS AT THE TWENTY-NINTH ANNUAL GENERAL MEETING—

Discussions on the Papers (*continued from previous Volume*)—
Mr. W. R. Chester's Paper on the Structural Capacity and Cost of Gas-Works 12
Professor Lewes's Paper on Carburetting Gases 14
Papers Read (*continued*)—
The External Vertical Standards of Gasholder Framework. By A. T. Walmisley, M.Inst.C.E., of London 17

ESSAYS, COMMENTARIES, AND REVIEWS:—

Gas and Water Companies in the Stock Market 26
Electric Lighting Memoranda 26
Gas Administration Systems 27

NOTES:—

An Improved Siemens Pyrometer 28
The Combustion of Nitrogen in Air 28
Air Pollution in Manchester and Salford 28

TECHNICAL RECORD:—

Société Technique du Gaz en France—Annual Congress at Tarbes . . . 28

REGISTER OF PATENTS:—

Gas Engine—Horn, W. W. (Vanduzen, B. C. and E. W.) 31
Open Gas Fires or Stoves—Bird, S. V., and Wood, J. S. 31
Gas or Vapour Engines—Day, J. 31
Union Gas Burners—Hislop, G. R. 31
Gas-Lamps—Zeitschel, B. 31
Roasting and Grilling by Gas—Goehde, R. 32
Manufacturing Illuminating Gas—Laurarre, C. B. de. 32
Gas Making Apparatus—Collins, C. R. 32
Patent Notices 32

PARLIAMENTARY INTELLIGENCE:—

Progress of Bills down to the Prorogation 33

LEGAL INTELLIGENCE:—

Staffordshire Quarter Sessions—The Assessment of the Birmingham Corporation Mains 33

MISCELLANEOUS:—

Southend Gas-Works—Commencement of a New Gasholder Tank . . . 34
London County Council—The Proposed Electric Lighting of the Thames Embankment 34
Coventry Corporation Gas Supply—The Annual Report; The Gas Siding Question 34
Electric Currents and Gas Meters and Fittings 35
Meeting of the Plymouth Gas Company 35
The Cape Town Gas-Works 36
Meeting of the Cape Town and District Gas Company, Limited 36
Metropolitan Water Supply Commission 37
Notes from Scotland 39
Current Sales of Gas Products 40
Coal Trade Reports 40
Gas and Water Companies' Stock and Share List 40

PARAGRAPHS.—Mr. Malcolm S. Greenough, 12—Reductions in the Price of the Electric Light, 12—A Suggestion for Minimizing Paraffin Lamp Accidents, 12—Adams on Timber Piling, 12—The Gaslight and Coke Company's Assessment Appeals, 25—Society of Arts, 25—The Brussels Electric Lighting Scheme, 26—Electric Lighting for Leeds, 30—The Rhyl Improvement Commissioners and the Gas-Works, 30—Electric Lighting for Huddersfield, 30—Rhyl Water Company, 30—The Alleged Theft of Coke at Ramsgate, 33—Exhibitions of Gas Appliances, 33—Sales of Shares, 33—Extended Use of Coal-Conveying Plant, 33—A Petroleum Oil Trust, 37—New York Water Supply, 37—Chambers of Commerce and Labour Disputes, 37—Water-Works for Norton (Malton), 38—Natural Gas in Pittsburgh, 39—Norwich Water-Works Company, 39—The Water Orders of the Present Session, 39—The Pamplona Water-Works Company, Limited, 39—Extensions and Improvements at the Leeds Water-Works, 41—The Sevenoaks Water Company's Provisional Order, 41.

NOTICE TO SUBSCRIBERS

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 5, 1892.

The Address of the President of the French Gas Managers.

THE Annual Meeting of the Société Technique de l'Industrie du Gaz en France was held at Tarbes from the 7th to the 12th ult., under the presidency of M. Edouard Melon, who delivered the Inaugural Address of which a full abstract translation appears in another column. Commenting on the technique of gas production, M. Melon remarked that his study of the progres of the gas industry in England had shown him that two interesting points—oxygen purification and oil carburetting—had divided professional opinion during the past year. Asking himself whether the oxygen process of purification is suitable for application in French gas-works, M. Melon observes that, as it appears to him, the process of which he calls Mr. Valon "the convinced apostle," has for its object to facilitate the use of lime without incurring the inconveniences which have caused this material to be dispensed with. This is not exactly the way in which Mr. Valon would in all probability recommend the oxygen process, the meaning of which M. Melon has evidently misunderstood. He recovers himself, however, in stating that, whatever may be the economical value of the process, it is necessary to be absolutely assured respecting the cost of the oxygen. He says that the talk in Paris is of oxygen at the price of 50 c. per cubic metre, which would consequently involve a constant charge of 0·5 c. per cubic metre for the continuous use of 1 per cent. of oxygen. Having regard to the conditions of gas purification prevailing in France, M. Melon thinks the oxygen process too costly, and recommends air; the fact being, of course, that only oxide, or some equivalent purifying "mass," is commonly employed in French gas-works. M. Melon next discusses methods of carburetting gas. Criticizing the Maxim-Clark process in the light of Mr. Frank Livesey's figures, M. Melon thinks it might answer very well in France, where the comparative prices of petroleum spirit and cannel coal are even more favourable to the former than in England. Speaking of carburetted water gas as an enricher of coal gas, M. Melon declares that this method will have a great future if the proportion of carbonic oxide in the product can be kept down to something like 10 per cent. He told his auditory that the advantage of these various processes is purely of an economical order, and if they were to be adopted in France it would certainly be rather for their commercial importance than for any technical advantage. This statement, let us say, is hardly fair to the water-gas systems. These must, of course, stand or fall in the first place by the price at which they can produce illuminating gas fit for distribution by ordinary coal-gas companies; but a perfected water-gas plant has other and special recommendations for gas managers, prominent among which are its great manufacturing capacity for the small space occupied, its ready availability for times of emergency, and its independence of stokers.

M. Melon was careful to re-state the proposition which he maintained before the last quinquennial commission of inquiry into the price of gas in Paris—that the cost of gas depends *essentially* upon the proportion of the cost of coal and the value of the residual products of carbonization; and that the technical improvements practicable for gas-works using the raw material recognized for the last twenty years as the best for the purpose, have no appreciable influence upon the question of prime cost. Permit us to observe here that it is one of the most astonishing things in the world that the skilful, educated, and logical gas engineers of France can talk in this way of gas making; ignoring all considerations as to the differences between retail and wholesale trading which apply to the gas industry as to all other branches of trade. To hear M. Melon, it is all the same to the Company and the public whether gas is made by millions of cubic metres in Paris for sale to the most densely-packed population on the Continent, or by a petty concern worked by a man and a boy. If but the invoice prices of coal, coke, tar, and ammonia are the same in both cases, the one should be able to sell gas as cheaply as the other. This is absurd; but it is only the *reductio ad absurdum* of M. Melon's proposition. It is the irrational Paris gas concession which accounts for all this curious pleading. But why defend such an arrangement by ascribing to it a rational basis which simply does not exist? If the original settlers of the Paris gas treaty had been less scientific and learned, and had known a little about business, this precious document would have been very differently worded, and such a state of things as the latest accounts of the Paris Gas Company reveal would have been obviated. This is, however, a sore point with our Parisian friends; and we will not enlarge upon it further.

An interesting feature of M. Melon's address is his disclosure respecting the formation of a *Syndicat Professionnel*

de l'Industrie du Gaz, which has been in existence for several weeks, under the presidency of M. Paul Mallet, who is also the new President of the Société Technique. All the officers of the Syndicate are leading officials of the Society, of which the new organization is aptly described as a "second incarnation." We do not exactly know the objects of the Syndicate; but the French law under which it has been constituted states that such societies are "to "study and defend economical, industrial, commercial, "and agricultural interests." They appear, therefore, to be some kind of Professional Unions, with rights of litigation. The Gas Syndicate will therefore act in a variety of ways denied to the Société Technique. It will be able to institute and defend lawsuits in the general interest of the gas industry of France, and will collect and distribute information useful to the members, and do other things that may appear needful from time to time.

The address contained a number of observations of national rather than universal interest, which need not therefore be dealt with here. It was, on the whole, a very worthy production; fully justifying the esteem in which the author is held by his colleagues, and which they proclaimed by elevating him to the honourable position of head of their useful Society.

Commercial Principles and State Laws.

SOMETHING that would be regarded in this old-fashioned country as no better than highwayman's justice has been perpetrated at Cleveland, Ohio—where, by the way, the gas consumers will now be looked after by Mr. Malcolm S. Greenough, late of Boston, Massachusetts. The laws of the State of Ohio give power to municipalities to fix the price at which gas shall be sold within their districts; and, in pursuance of this statutory sanction, the city authorities of Cleveland recently decided that the local Gas Companies (of which there may be half-a-dozen, for all we know) must supply gas for 80c. per 1000 cubic feet, and pay to the City Treasurer a tax of 6½ per cent. upon the gross rental for the privilege of doing so. After raising a storm of protests, and averring in the strongest terms that they never, never could submit to such an order, which would mean bankruptcy for them, the Gas Companies have given in, and are now meekly preparing to try whether they meant what they said about the effect of the new ordinance. As against this Cleveland surrender must be set the contemporary case of Des Moines, Indiana, where, under different State laws, a like attempt to prescribe the price at which a Gas Company shall sell their staple product was quashed by a Judge as being both unreasonable and unconstitutional. These items of American gas news are bewildering to an interested commentator who merely wishes to learn, from what is done in different parts of the world, how such matters are managed. Home Rule for towns may be a very good thing on many accounts; but when it comes to a Municipality ordering the local Gas Company to make out their bills for gas at any rate that seems reasonable to the majority of the Town Council for the time being, it may be permissible to doubt whether this is not carrying an idea too far. Supposing the community were to burn, not gas, but some other article of consumption, is it to be understood that the Constitution of the United States warrants the purchaser in fixing his own price, and compelling the purveyor to supply him at this fancy figure, or shut up his shop? If so, wherein does this way of doing business differ from that of a courteous highwayman, who should profess to scorn the notion of "robbing" his victims, but preferred to "buy" their portable property at his own valuation, paying for it with an agreeable smile or a polite bow, instead of with "filthy "lucre"? We are, of course, supremely ignorant in these matters. American critics of the JOURNAL have assured us many times that we know nothing whatever about the great American gas business; and we must rest content to bear the reproach. Meanwhile, we venture to express the conviction that the more this kind of business is left to the natives, who presumably do know something about it, the better. It will be perfectly useless for anybody to come over here and endeavour to attract British capital for gas undertakings in the United States, while such performances as that of Cleveland pass current under the sanction of State laws. It is wholly beside the question whether the Cleveland Gas Companies can or can not afford to sell gas at the compulsory price named. If they can, and did not, the more shame to them. The objection we take to these proceedings is based upon general grounds. It is inconsistent with commercial principles, which should be superior to all pettifogging local legislatures, that one party to a trading transaction should fix the selling price. This sort of thing may be good enough for Ohio, which we believe is also the home of M'Kinley, of Tariff notoriety; but it will remain an article of exclusively local consumption.

Municipalism in Manchester and Salford.

MUNICIPALISM in England is getting on, or is going backward, we hardly know which. Last week there appeared in the *Daily Graphic* a fervid glorification of the workings of modern Municipalism, as manifested in the case of Manchester. Among other subjects of admiration which the writer of this notice discovered in that city, he, of course, included the Town Hall, which he described as having been built out of the profits of the municipal gas and water undertakings; and he went on to describe Manchester gas as being both better and cheaper than that supplied to London by its "half-dozen Gas Com-"panies." From this sample of his information it may be concluded that the reporter was not particularly well qualified to pass an opinion upon the technical question of the quality of gas; but it would be pedantic to insist overmuch upon this point. We meet our observer of Manchester things and ways upon clearer ground when, after recounting how well the local affairs seem to be managed there, he remarks that people in this part of England are amused rather than otherwise when they read of the exaggerated fears entertained in some other localities of the possible results of a free and full-powered Municipalism. Yet if this inquirer had ventured across the border that divides Manchester from Salford, and had pursued his investigations in the latter region, he would quickly have learnt that local self-government is not without its drawbacks. To say nothing about the miserable scandals that have made the name of Salford a byword in England for years past, there has lately been a performance by the Salford Town Council, as to the character of which we should like to have the opinion of the *Daily Graphic* commissioner. It has been regarded by the engineering press as so remarkable as to merit particular notice. The facts are simply these: Upon the retirement of Mr. Arthur Jacob, M.Inst.C.E., who was Borough Engineer of Salford for many years, applications were, as is usual, invited for the post. The claims of the candidates were investigated by a Committee of the Town Council, who cut the applicants down to a short list of five, and finally recommended Mr. John Price, of Toxteth Park, Liverpool, for the appointment. Accordingly, at the next Council meeting, the Mayor, as Chairman of the General Purposes Committee as well as of the Selection Committee, proposed this appointment; remarking that Mr. Price was "head and shoulders in front of all the "other candidates," and reminding the Council that it had always been a constitutional usage of the Corporation that the action of Committees should be supported. However, notwithstanding this warning of the Mayor, who must have known what was coming, a couple of Aldermen proposed as an amendment the appointment of a local man, who had been a town councillor or had had something to do with the Corporation; and the Council agreed to their proposal. Thus the recommendation of the Selection Committee was overridden, and the peculiar quality of municipal administration in Salford was once more signalized.

A Political Assault upon the Patent Law.

WHEN we began to notice the particular developments which are arising out of the present electioneering contest, and which might be regarded as more or less interesting for readers of the JOURNAL in their professional capacity, we little thought that, in order to round off our notices, it would be necessary to take a glance at the Patent Law. Yet a curious advertisement of a body calling itself the Patent Law Reform Association has been brought under our attention, according to which the task of grappling with the supposed imperfections and iniquities of the existing patent law of England is to be tacked on to the political programme of a group of politicians of a certain brand. All the Vice-Presidents and Members of Council of this pretentious Association, which has its headquarters in Lord Street, Liverpool, are candidates for Parliament of one and the same Party; the object

of the organization being obviously to create the impression that it is only such as these signatories who take any interest in the reform of our patent laws. This is, of course, sheer electioneering trickery, designed to catch the intelligent mechanic's vote; and it is a flagrant violation of the unwritten law, that matters of this nature should be left outside the arena dedicated to the conflict of political parties, either of this or of any other country. What chance is there of projected reforms of any national institution being attended to on their merits, if they are first degraded by being included in the election manifestoes of a set of inferior politicians? But it is hardly possible, to treat the suggestion of this precious Association on its merits, and retain a serious countenance. The organization has no other aim, according to its own showing, than doing away with the British patent system, and pressing the adoption of the American patent law. Mr. W. S. Gilbert has said some scathing things about "The idiot who praises, with exasperating tone, All "centuries but this, and every country but his own;" and one fit subject of these denunciations would appear to have his domicile in Lord Street, Liverpool. Our patent system may not be perfect; but what of the American? Let us hear what the "organ" of a firm of Yankee patent attorneys—the *Scientific American*—says of a recent example of the working of this vaunted law: "Three "fifteen-year-old patent applications of Thomas A. Edison "for telephone transmitters went to issue last week, after "such long delay that the English patents, applied for "after the American, had been examined, granted, "gone to issue, run their term of fourteen years, "and expired, before the American patents were issued." Even the *Scientific American* agrees that this is a great reproach to United States patent practice and the state of the law; yet such is the working of the system which the Liverpool clique of politicians wish to impose upon the inventors and the people of this country! If this is the best that can be advanced with regard to the subject, "Reform of the Patent Law upon American lines" will hardly take rank as a first-class "cry" for the election that is now upon us.

Another Smoke Abatement Illusion.

A London newspaper which, it is hardly necessary to remark, boasts of its large circulation, notices what is described as the "latest attempt to circumvent the "London smoke." The idea is credited to an amateur inventor, Colonel Dulier, C.B., who is reported to propose mixing the smoke as it leaves the flue with a small quantity of steam generated in a boiler forming part of the kitchen range. By this device it is believed that the smoke of the fire would be so thoroughly washed of all soot and dust, and of most of its load of sulphurous acid gas, as to be practically innocuous. There, is, however, a drawback to this project, which even the newspaper writer recognizes as serious. It is pointed out that a kitchen range, burning 20 lbs of coal per hour, would require 10 gallons of water per hour to work the smoke-purifying apparatus; and this consideration is regarded (with regret) as sufficient to prevent the general use of the plan in London. At the same time, to salve the inventor's feelings, the testimony is offered that the plan is "undoubtedly efficient." It is when one encounters such idiotcy as this in the daily newspapers that one cannot help wondering whether the age is that of the nineteenth century, with its University Extension lectures and other agencies for the dissemination of systematized common sense, or whether we yet live in an era when the application of a saffron bag to the pit of the stomach can be regarded as a reliable cure for all the ills that flesh is heir to. Colonel Dulier's crude suggestion is, in all probability, the result of rumination over the recent display upon the Thames Embankment of a smoke-washing apparatus which was supposed to do great things, but which somehow has not been heard of lately. Smoke abatement has always been a pet study of a certain order of *quidnuncs*, some of whom have propounded remedies for the trouble quite as fantastic and impracticable as the one now under notice; but it is deplorable that a problem of such real importance, of which it may be said that those experts who, from the careful attention they have given to it, know most about it, are also the most despondent of finding an acceptable solution, should be made ridiculous by the handling of triflers.

WATER AND SANITARY AFFAIRS.

Evidence entirely on behalf of the London County Council occupied the two sittings of the Metropolitan Water Supply Commission last week. Mr. W. H. Dickinson, the Deputy-Chairman of the Council, stated that, after considering the reports placed before them, that body had decided not to take up any definite position, either favourable or antagonistic to the present methods of supply. In regard to these reports, the Council did not make themselves responsible for the statements or arguments contained therein; but the gentlemen who had drawn them up put them forward as from themselves. If this be so, the County Council may be said to disappear from the scene; the place supposed to belong to this august body being taken by sundry isolated gentlemen, for whose statements the Council are not "responsible." Yet the Royal Commission had asked to be furnished with some indication of the views entertained by the London Council with respect to the Metropolitan Water Supply; and the Deputy-Chairman acknowledges that, in consequence of this request, a "memorandum" was prepared and discussed by the Water Committee. As the result, Mr. Dickinson states, certain resolutions "were "adopted." No doubt; but by whom? Not merely by the Committee, but by the Council, who, in regard to this memorandum, are reported to have confirmed and adopted "the opinions and conclusions expressed therein." It was thus that the Council proposed fifty years as the period for which the water supply should be rendered adequate; also that a population of 12,500,000 should be provided for—the daily supply to be not less than 35 gallons per head. So far the Council must be understood to take up a "definite position," unless there is a subsequent withdrawal, though not formally declared. Neither can we forget that these propositions formed part of a long report, which went forth to the public as expressing the "Views "of the County Council" on the subject of the London Water Supply. It may matter little whether the Council stand by their colours or not; but it is worth a little consideration as to the cause of this somewhat halting attitude. It would seem that the Council wish to throw as much responsibility as possible upon the Commission, so as not to appear at last as if defeated in an attempt to upset the Water Companies. The London County Council simply "supply information," and leave the consequences in the hands of the Commission. Very right, and probably very wise.

On the question of quality as attaching to the London Water Supply, it is evident that the Council have found it very difficult to get up a case. The witnesses on whom they relied were not found to be quite in agreement with one another. The Council went deeply into the matter; but Mr. Dickinson says "they had such "antagonistic views submitted to them, that they felt it "was impossible for them to come to any definite con-"clusion at present on the matter." Accordingly, they decided that this part of the subject "should be left to be "investigated by the Commission." But while thus holding off from the question as to whether the supply is good or not, the Council are ready with evidence that a certain amount of pollution affects the source. Mr. Dibdin, the Chemist to the Council, was examined before the Commission at very great length on this point last Tuesday; but while giving evidence as to the entrance of sewage into certain parts of the stream, this witness also signified that "the stoppage of a great deal of the pol-"lution" was perfectly practicable. It was his opinion that, in all cases where a sewage effluent passed into a stream connected with a drinking supply, it should be thoroughly filtered through land. A peculiar piece of evidence was given by Dr. Murphy, the Medical Officer of Health for the Administrative County, who stated that "the London death-rate from enteric fever bore favourable "comparison with that in other towns having public "water supplies which were not polluted by excrement." The statement is valuable, though the comparison can scarcely be regarded as altogether correct. How does Dr. Murphy prove that the water supply of London is "polluted" in the manner he describes? Some few and limited portions of the main stream may be thus polluted; but has Dr. Murphy found such an ingredient to exist in the "supply"? It is very common to confound the supply with the source, and to characterize the source

by something which only applies to a part of it. Still it is satisfactory to find that, having made a comparison in regard to typhoid fever between London and fourteen large towns where the water supply is understood to be pure, Dr. Murphy draws an inference which is favourable, "so "far as it goes," to "the wholesomeness of the London "Water Supply as compared with that of other towns." We submit that the character of the supply is the real test; and it was on this point that much of the evidence given by Dr. Frankland was based. Mr. Dibdin has been taking samples from the rivers, and hence the results may differ from those which relate to the supply, though in many respects the evidence given by the latter witness agreed with that of the former. We observe that Mr. Dibdin made a careful distinction between "pollution" and "organic impurity." The distinction is correct, and possesses practical importance.

Mr. Malcolm S. Greenough, of Boston (U.S.A.), who is personally know to many of our readers, asks us to mention that he is leaving Boston to become Vice-President and General Manager of the Cleveland (Ohio) Gaslight Company.

Reductions in the Price of the Electric Light.—In the paragraph last week referring to the Eastbourne Electric Lighting Company, it was mentioned that the Directors had decided to reduce the price of current from 10d. to 9d. per unit as from the 30th ult. A reduction to a similar extent has taken place in the Metropolis; the Westminster Electric Supply Corporation, Limited, having notified that, as from the 1st inst., their price will be 7d. per unit.

A Suggestion for Minimizing Paraffin Lamp Accidents.—A correspondent, signing himself "Humanity," has written to suggest that each candidate—whether Liberal or Conservative—for a seat in the new Parliament shall be asked to pledge himself to support a short Act specifying that every paraffin lamp is to have affixed to it an automatic extinguisher, as recommended in the reports of Sir F. Abel, Mr. Boverton Redwood, and Colonel Majendie. The writer points out that there are about 10 million of these lamps in use in the United Kingdom alone; and something like 300 deaths are stated to be caused annually by accidents through the use of unsafe lamps. In addition to this loss of life, 10 per cent. of the fires which occur are traceable to this source. "Humanity" urges that something should be done without delay; and the above is the direction in which he thinks the first steps should be taken.

Adams on Timber Piling.—A paper read before the Society of Architects on "Timber Piling," by Professor Henry Adams, has been reprinted with explanatory diagrams; and it has been found so useful that a second edition has become necessary. We did not notice the paper at the time, and therefore take this opportunity for recommending all students of engineering construction to procure a copy of the reprint; and we can promise that whoever does so will have at command an exceedingly useful epitome of practical information on the subject. All that Professor Adams does in this way, he does thoroughly—not with any display of abstruse learning, but keeping in view the ordinary requirements of constructors. Thus, in the pamphlet now under notice, the author starts by taking his reader into the timber market, the mysteries of which he explains, so far as they relate to piling material, before going on to describe how piling is done. He finishes by descanting upon the value and effect of piling for foundations. As to this, we can offer a remark. It is quite true, as Mr. Adams says, that, since the introduction of Portland cement concrete as a material for foundations, piling is not nearly so much resorted to as formerly. It is, however, still indispensable sometimes, and enables loads to be carried over soils that could not be treated in any other way. It is not fair, of course, to criticize a paper as if it were a treatise; but we venture to ask whether Professor Adams has ever had his attention called to the remarkable fact that in some soils piles that will at first sink almost by their own weight will, if left for a time, "set" sufficiently to bear heavy loads—not, of course, of a statical kind. Piles are most employed now-a-days for jetties, dock walling, railroads over swamp lands, &c. It is in such cases that the power of piles to bear when they have merely stuck fast sometimes becomes valuable. Circumstances are, of course, everything in this matter; but the ability to turn circumstance to account is one of the attributes of the trustworthy engineer. We read lately in the *Journal* of the American Society of Engineers a statement of how, when a certain swamp had to be crossed by a railway, the attempt to find a sound bottom by the longest piles resulted in failure. The piles could easily be driven out of sight by the ordinary method. It was accidentally discovered, however, that if every pile was merely sunk into its place by the added weight of a heavy man, and left there for a while, it would answer every purpose; and, as a matter of fact, trains are actually running over viaducts that were piled in this peculiar manner.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE TWENTY-NINTH ANNUAL GENERAL MEETING,

HELD AT THE

INSTITUTION OF CIVIL ENGINEERS, JUNE 14, 15, & 16, 1892.

Mr. W. A. VALON, Assoc.M.Inst.C.E., President.

DISCUSSIONS ON THE PAPERS.

We continue to-day the report, commenced in the last number of the JOURNAL, of the discussions on the papers read at the above meeting.

MR. CHESTER'S PAPER ON THE STRUCTURAL CAPACITY AND COST OF GAS-WORKS.*

The PRESIDENT said the paper would be of considerable value when published in the Transactions of the Institute. Mr. Chester had been at great pains to give the result of practical work in the construction of gas-works.

Mr. W. HARDIE, jun. (Tynemouth), said there was no question that the subject dealt with in the paper was one of very great importance indeed, because there was no part of the work with which gas managers had to do which bore more largely on the selling price of gas than the first cost of erecting the works. Mr. Chester had referred to the largeness of the work; and to a great extent he took Mr. Wyatt's papers on the "Structural Capacity and Cost of Gas-Works" † as a sort of model on which to base his items. In this, he (Mr. Hardie) thought Mr. Chester was correct. Looking generally over the paper, it would be found, when properly compared, that the structural cost in the two cases came out very nearly alike. One point of novelty was putting the engines, exhausters, governors, and station meters all under one roof; but he did not see why this should not be a good thing. It ought to be a saving in the cost of erection; and it would also probably effect economy in working. He found the purifying capacity was about that to which he was accustomed; and the arrangement of working two sets of four purifiers alternately with lime and oxide was the same as his own. He did not say that this was a very scientific way of reducing the compounds; but he knew, as a matter of fact, that they did keep them down to a very fair average. The reason probably was that sometimes one set was in a good state, and sometimes the other; and so they balanced. He did not think the members could calculate with any certainty on keeping the sulphur compounds down with such an arrangement on any scientific basis. Another point was with regard to the question of gasholders. He noticed that Mr. Chester had only storeage for 0·4 of the day's production. This seemed to him very small indeed; and he would like to know whether he did not find very great inconvenience therefrom, and whether it did not entail on him in the winter time a considerable amount of expenditure by keeping the retorts hanging, so as to be prepared for any slight emergency. The chief value of the paper would be as a guide and reference in erecting new works.

Mr. J. WEST (Manchester) said he had been intimately connected with Mr. Chester for many years, and knew how accurate and careful he was in dealing with figures; and therefore he felt confident that all the data given in the paper could be implicitly relied upon. He was familiar with the structures to which the figures bore reference; and he knew that they were of considerable stability, though not more than was necessary, and that they were also architectural, and pleasing to the eye, though there was no great expense incurred for elaboration. In these days it was very important to have sufficient stability and the best machinery, without adding too much to the capital account. Mr. Chester had been obliged to arrange the various meters and governors with the engines as he had done, because he was confined for space; but he (Mr. West) did not think he could have had a better or more economical arrangement. As long as

* See JOURNAL for the 28th ult., p. 1229.

† *Ibid.*, Vol. L., p. 662; and Vol. LI., p. 773.

Mr. Chester kept to facts and figures, what he said could be relied upon; but he thought he went a little into speculation when he suggested that he could have done the work for very much less if he had started afresh. He (Mr. West) was bound to say he thought there would be great difficulty in keeping the expenditure as low as £4 a ton, if he put up the erections in the same manner as he had done those described. He was aware Mr. Chester had completed the building and plant at a very low figure, because in that district materials were cheap.

Mr. H. Ashton Hill (Wallasey) said he was particularly interested in the paper, because he was about to construct a works to make from 1 to 1½ millions per day. With reference to coal-stores, he had an idea about the storeage of the raw material. He did not altogether believe in having very large stores. If he wanted 3000 tons of coal stored, he put it in a bay, and did not wish to use it. He did not care if he never used it; but then he had his coal alongside his retort-house, and his stokers unloaded it. He did not see the necessity for having a lot of men unloading coal, putting it into one bay and then taking it out for use, and bringing new coal and putting it there. His opinion was that it was not worth while to provide much covered coal storeage, but to put it out in the open, and leave it in case of an emergency. In connection with siding accommodation, he could quite understand that Mr. Chester had to "cut his coat according to his cloth," and design his works according to his land. In a new works, he should try and avoid having turntables. He wanted to introduce a locomotive; and, if possible, he should do away with turntables, and have sidings in preference. With regard to the purifiers being in open sheds, instead of in a building, he should rather gather that the shed was there already, and that the house was the new building. But he should be glad to know what Mr. Chester's ideas were with regard to that, and what were the relative advantages and cost of a shed as compared with a brick building. As to the meters, governors, and so on, being in the same house, he agreed with placing them in one building. Gas managers often did so practically, although division walls were built between—the pumps being in one division, and the exhauster in another; and they might as well leave the divisions out, and have all the apparatus in one room.

Mr. C. S. Ellery (Bath) said he had lately had some experience which might be interesting to those who were contemplating storing coal in the open. Their accommodation was not too extensive; and they put a stock of coal in the open air. But after the very hot weather through which they had passed, they were visited with a heavy storm one night, and the next morning he saw that storing coal in this way did not answer. Something had been washed out of it—he could not tell exactly what it was, because the analysis had not yet been completed; but it was very evident, from the colour of the water running from the heap, that some chemical action was in process. It was hard Derbyshire coal; and the incident at once proved to him that it ought to be kept under cover. He quite agreed with those who had expressed appreciation of the labour of Mr. Chester; but they must guard themselves in using his figures. They would apply in Nottingham, but might not do so in other places. While they would be useful for comparison, one could not say that other works should not cost more, or that they might not be erected for less. For one thing, the foundation might vary considerably; again, he saw that the retort-house was only 50 feet wide. Taking out of this 20 feet for the retorts (which was a usual length, though Mr. Chester's appeared to be shorter), it only left 15 feet for charging room. All these points affected the question on making comparisons; and if the result did not come out quite the same, they must not blame either the figures in the paper or their own. Again, with regard to the storeage of coke, he should like to know the advantage of covering over the coke-yard. He would rather cover the coal than the coke. Perhaps if this expense were left out, the cost would be reduced. Mr. Chester had drawn attention to another matter which the members would do well to follow up. He traced back the condensation to the mouthpieces. Sometimes statements were not so explicit. Condensation must begin at the mouthpieces; and they must thank Mr. Chester for emphasizing this fact. Another point he was rather surprised at was putting the tar and liquor tanks over the boilers; and he should like to know if Mr. Chester had taken the temperature of his liquor, or adopted any means to prevent evaporation. His (Mr. Ellery's) experience was that, with even the direct rays of the sun, unless the tanks were covered in, there was a danger of losing ammonia. The question whether or not it was an advantage to cover the purifiers was debateable. At some works they were erected in the open air—thus keeping down the cost very considerably. With regard to area, some were working with considerably less than 14 feet per 1000 cubic feet. On this point he should differ from Mr. Chester, and say that they would do well to exceed this figure rather than keep below it.

Mr. Chester, in reply, said he did not agree with Mr. Hardie in saying there was no scientific basis for dealing with the sulphur compounds in the way suggested. The "proof of the pudding was in the eating." They were certainly able to keep the sulphur compounds under control by having the purifiers working in a series of four, and alternate boxes of lime and oxide, without any of the complicated difficulty of dividing the purifiers into series of oxide, carbonate, sulphide, and sulphuretted hydrogen. The simple arrangement referred to, combined with sufficient area, was all that was needed for the purpose. The gasholder capacity being so small would, no doubt, be inconvenient, but for the fact that the works were carried on in conjunction with two other stations, where the storeage was greater in proportion to the make; and the consequence was that, during the winter months, they were able to store and send out gas from the other works. The total gasholder capacity was slightly in excess of the maximum daily production. Mr. West had been complimentary in saying that the figures given might be relied upon. This had been his (Mr. Chester's) special object—not to draw upon his imagination, but in almost every case to give actual facts. There were only two items which were based on estimates. The first was the cost of the land and drains; because, the ground being purchased a great many years ago, when it was much less valuable than now, he had taken a mean figure at which land for gas-works purposes might be obtained. The other item was the engineering and parliamentary expenses, which he had taken at about 7½ per cent.—a figure which Mr. Wyatt gave, and he had adopted. Mr. West did not see how it was possible to make any material reduction in the capital cost of the works; but he (Mr. Chester) might point out that, in the item of gasholders alone, there would be no difficulty in saving 10s. a ton, if, instead of the small holders which were constructed in past years at considerable cost, one or two larger ones were provided, which could be done at something like half the capital outlay. Mr. Hill did not see much object in putting coal under cover, except to a limited extent; and he quite agreed with him in this. It was only a question of extent. He had stored under cover 14 days' supply of coal, which seemed to him to be a limited quantity, with another 14 days' storeage in the yard—giving a total of a month's supply. This was, in his opinion, the minimum that ought to be allowed. They had, as a rule, a very much larger stock, so as to be provided against emergency; and at the period when the collieries enjoyed their last "holiday," he was in the fortunate position of having about three months' supply in stock. It was undoubtedly desirable to avoid turntables wherever this could be done. With regard to purifiers being placed in a house or in a shed, as far as the cost was concerned, there was very little difference, if allowance was made for the cost of the tar and liquor tanks and the area of shed necessary for the preparation of the lime and oxide. He quite agreed with Mr. Ellery that the figures would not be universally applicable. He had given them as figures pertaining to a particular works, and they could be taken as a guide, and nothing more, as to what might be expected in other places. Then he asked why there was storeage accommodation for coke under cover. The reason was because gas managers sold coke, not water, which was an important consideration. If the coke were kept in the yard, they might, no doubt, be able to sell a larger quantity of it, *plus* water, per ton of coal. But it had been a custom almost from time immemorial in Nottingham to sell it without the water; and therefore they provided storeage accommodation under cover. As to the loss of ammoniacal liquor from placing the tanks over the boiler, they were only put there for the purpose of measuring the liquor into the boats to go away to the chemical works. The liquor

used for the scrubbers was pumped direct out of the well, to suit the requirements of the scrubbers, and not into these tanks at all. He had had purifiers both exposed and under cover; but a man who had them in these positions realized that there were considerable advantages in having them under cover. It was much more comfortable, and one could utilize the cover for the purpose of preparing the lime, without being troubled with all sorts of difficulties arising from moisture and the freezing of the lutes, or from the saturation of the oxide or lime by the deposition of a large quantity of moisture, which to some extent interfered with the proper action of the purifying material.

PROFESSOR LEWES'S PAPER ON CARBURETTING GASES.*

Dr. THORNE said that when he undertook to read a paper on the "Influence of Possible Diluents on Illuminating Gases," his aim was to raise discussion upon, and bring into prominence, a matter which, in his opinion, had until quite recently been too much neglected by gas engineers—viz., the effect of different diluents upon the illuminating power of carburetted gases. He hoped to have made a series of experiments on this subject; but he had been interrupted, and was not able to complete them. Finding that, in a paper under a different heading, Professor Lewes was treating almost identically the same subject, and on similar lines, he had suggested to the President that it would be better to withdraw his paper for the present, and content himself with making some remarks upon that of Professor Lewes. The latter had noticed Dr. Percy Frankland's experiments, in which he showed the effect of hydrogen and carbon monoxide as diluents; and he had also briefly referred to the same author's work on the effect of methane. Both Dr. Frankland's and Professor Lewes's experiments showed that in some instances the illuminating effect of a mixture of ethylene and hydrogen was higher than the effect as calculated from the illuminating power of the ethylene in the mixture. In the case of methane, this effect was still more marked. One of the tables in the paper gave Dr. Frankland's results, from which it would be found that, counting methane as an illuminating gas having an illuminating power of 5 candles—the experiments of Mr. Lewis T. Wright, Mr. Anderson, and others, pointing to this value—the increased illuminating effect produced by the ethylene on methane was very marked indeed. With 87 per cent. Dr. Frankland observed 57·9 candles; whereas theoretically there should be 59·5 candles; with 69 per cent., 47·9 candles observed, against 48·9 candles calculated; with 57·7 per cent., 40·4 candles observed, against 41·6 candles calculated. So far the theoretical was slightly higher than the observed effect. This was until the percentage of ethylene was reduced to something like half the total gas experimented upon; but when dilution went further than that, a marked change was observed. The next mixture tested contained 39·9 per cent. of ethylene; and here the illuminating effect observed was 33·2 candles, whereas the calculated effect—always allowing for the 5 candles taken as the value of the methane—gave only 27·8 candles, or a difference of 5·4 candles in favour of the mixture. Of the mixtures containing 13 per cent. of ethylene, the illuminating power obtained was 19·5 candles, whereas the theoretical effect should be 13·3 candles—a gain of 6·2 candles. With only 7·9 per cent. of ethylene, the illuminating power observed was 17·6 candles, whereas the calculated amount would be 10 candles—a gain of 7·6 candles. These results should be compared with those obtained with carbon monoxide and hydrogen, where, below a certain percentage of illuminant, the illuminating power sank much more rapidly than it should do according to theory. Those experiments, together with the further ones Professor Lewes had shown, brought very prominently forward the extreme importance of taking into consideration, in deciding what should be used to enrich, and what gas should be enriched, the effect of the diluent gases, which generally were looked upon as simple diluents, playing no important part in the effect produced. From a purely illuminating point of view, methane certainly seemed to take a very prominent place, and to be the most advantageous diluent. Of course, as far as one could see at present, methane was entirely out of the field from a practical point of view, except in so far as it existed in certain proportions in ordinary coal gas. But, even apart from the practical difficulty of obtaining methane, other considerations came into play; for, although the illuminating effect of the enriched methane would be very considerable, there would be the detrimental results of the very great amount of heat given out, and the large quantity of air used up and vitiated by the enriched methane flame. Roughly speaking, taking gases of equal illuminating power, using carburetted hydrogen, carburetted carbon monoxide, and carburetted methane, the latter would use up between three and four times as much air as either of the others, and produce between two and three times as much heat. Thus, even from the point of view of the best gas for illuminating purposes, carburetted methane had very great drawbacks. Turning to the other two available diluents—hydrogen and carbon monoxide—the latter, in anything like a pure state, was out of the question from a practical point of view, both on account of cost, and also from its highly poisonous character. They were therefore reduced very much to the choice of two gases, apart from coal gas—viz., hydrogen and water gas. These two, and inferior coal gas, might be carburetted up to any point desired. Of course, the question of the cost of carburetted water gas, as compared with enriched coal gas, was one which it was very difficult to estimate in England; and it was still more difficult to estimate the possibility of their relative cost in the future. As there was no doubt, however, that the question what gas was to be used in the future was becoming an important point for discussion, it was well to consider carefully the influence of these various diluents; and, in Professor Lewes's paper, gas managers would find a great deal of interesting material well worth study. They were still very far from the age predicted when coal would be extinct. But all who were connected with the manufacture of coal gas knew that coal, and especially cannel coal, was becoming very much more expensive; and, even already, many other non-illuminating gases were being introduced to take the place of the non-illuminating constituents of the coal gas as a diluent. The results obtained by Professor Lewes and Dr. Frankland showed clearly that the hydrogen and carbon monoxide had in many respects very similar effects, but that, on the whole, the illumination produced by carburetted hydrogen was greater than that yielded by carburetted carbon monoxide; and certainly all the evidence so far seemed to be in favour of getting as near as possible to pure hydrogen as the diluent to be carburetted, not only on account of the increased illuminating effect, but of the lessened deterioration of the air of the room, and of the non-poisonous character of the hydrogen as compared with carbon monoxide, or any gas containing a considerable quantity of the latter. Taking these two—hydrogen and water gas—one came to the question of the possibility of their economical production; and certainly until recently there seemed no likelihood of hydrogen being obtained in any way so cheaply as to make it available as a carrier of illuminating hydrocarbons, and a competitor with water gas. But Professor Lewes had briefly mentioned that he had lately been working on a hydrogen apparatus; and, from the results he (Dr. Thorne) saw from it in its earlier stages some few months ago, there certainly seemed to be a good hope of hydrogen being brought soon within the range of practical gases for gas-making purposes. If this could be done, it seemed to him that hydrogen must have advantages in many ways over water gas. The increased effect of the carburetted hydrogen, as compared with carburetted carbon monoxide, was difficult to explain clearly. But it rather seemed as though it depended very largely upon the temperature of the flame (the temperature of hydrogen being undoubtedly somewhat, although not greatly, higher than that of carbon monoxide), and also on account of the lower specific heat of the water vapour produced by the combustion of hydrogen, compared with that of the carbonic acid produced by the combustion of carbon monoxide. In the course of 1889 and 1890, Herr Knublauch, of the Cologne Gas-Works, published an interesting series of papers in the *Journal für Gasbeleuchtung*, on the illuminating effect of benzene added to gases. He took as his first basis a rather low or medium quality (about 15-candle) coal gas; and he found that the illuminating effect of some additions of benzene was very great. In his experiments he added to this coal gas quantities of benzene, which raised the illuminating power about 1½ candles; and from the effects produced from these small quantities, he calculated

* See JOURNAL for the 28th ult., p. 1232.

the effect of benzene, and made it out to be something like six times that of equal volumes of ethylene. But gas managers should be a little cautious in accepting this very high standard of the illuminating power of benzene, for the reasons just discussed—viz., that, when small quantities of high illuminating hydrocarbons were added to gases which in themselves had a certain amount of illuminating power, or what he might perhaps call potential illuminating power, an increase of illuminating effect was obtained which was not solely due to the hydrocarbon added, but was in part owing to the gas used as a basis. For instance, where Dr. Percy Frankland added small percentages of ethylene to methane, he obtained effects which were nearly double what they should have been theoretically. If this, as seemed probable, was the same with coal gas (and the speaker's experience had confirmed this), it was hardly fair to calculate from this increase up to pure benzene, and so get what Knublauch called the illuminating effect of benzene. These numbers, therefore, should be taken with care, and also the deductions drawn from them. The author seemed to have gone about his experiments with a bias in favour of the immense advantage of benzene over ethylene; and, without intending to do so, he carried that bias right through his work. He concluded by drawing up a formula which, he said, would enable anyone, with a given illuminating power of a gas, and a given total absorption of unsaturated and liquid hydrocarbon, to determine the relative proportions of the gaseous unsaturated hydrocarbons, and the liquid hydrocarbons such as benzene. He based his formula partly on the fact that, with ethylene and with ether, he obtained very similar illuminating effects, and that in ethylene he had two carbon atoms to the molecular volume, and in ether four; but that, notwithstanding this difference, and the greater density of the carbon, he had like results in what might be called the paraffin series. He (Dr. Thorne) thought the choice of materials was a bad one. One could not by any means compare ether and ethylene. If ethylene were compared with butylene, where one had a four-carbon molecule, a much greater illuminating effect would be obtained with butylene than with ether. These experiments were most valuable; but he had gone too far in the speculative line in drawing his conclusions. This paper of Professor Lewes would be of great value in calling prominent attention to the effect of the diluents; and he hoped that managers of gas-works who were considering whether it might be advantageous, as was already done in some works, to supplement their coal gas with carburetted water gas, or some other gas, would take this question more carefully into consideration, and set on foot experiments on a large scale which would throw more light on the subject than the small ones could do which had up to now been carried out.

Mr. B. H. Thwaite (Liverpool) said time did not admit of his offering any lengthened criticism of the paper; but he should like to ask Professor Lewes one or two questions, especially as there seemed to be considerable discrepancy between the results now stated and those given by Professor Foster on the previous day. With respect to the statement that he could produce hydrogen as cheaply as water gas, he (Mr. Thwaite) was satisfied, from his own experience as to that gas and the method of its production, that he would find "the game was not worth the candle." Then he spoke of the specific heat in the case of carbon dioxide, but did not mention the latent heat of steam due to the oxidation of the hydrogen. He (the speaker) quite agreed with Professor Lewes that it was difficult to synthesize the proportion of the diluent gas to be added for specific photometric value. He hoped he would not take these critical observations in the wrong light, because he was quite as anxious as was the author of the paper to arrive at the strict truth on this important question.

Professor Foster said there was one point in the paper to which he would call attention, which the author had alluded to cursorily, quoting from Mr. Lacey. The question was a very wide one; he referred to the so-called carrying power of gases. As a law in physics, it was known to everyone that the tension of the vapour of liquid was a function of the temperature; and the amount of vapour one could get into a gas was entirely dependent on the temperature, even in the case of inert gases such as hydrogen, nitrogen, carbon dioxide, &c.—that was to say, a given volume of each of these dissimilar gases took up the same amount of a given vapour at the same temperature. Professor Lewes had brought forward some figures in illustration of that well-known physical law. But now came the modification of this law. Supposing one had two vapours, A and B, one of which could act on the other, one would have a chemical compound of weak stability. What happened then? A took out B, and the couple left the gas. This was really what had been in the gas engineer's mind. He thought, in speaking of the carrying power of gases, he had been rather vague in his language, although the idea at first sight appeared perfectly well founded on the fact that a certain vapour could absorb other gases, or rather other vapours, and, when the temperature fell, the two or more joined company. It was really a case of the solution of one by the other, after which they left the gas. Of course, it was stated in books on physics that the tension of two vapours was the sum of the tension exerted by each separately, if there was no natural chemical action. This was where the difficulty and uncertainty came in. With reference to Dr. Thorne's observation about the relation of ordinary ether to ethylene, he did not remember any reference to ether in Dr. Frankland's experiments, although it was some time since he read the accounts of them. However, the two substances were not comparable; they did not belong to the same series. If they took butylene and ethylene, they had members of the same family; and those who were present at Carlisle last year would remember that he referred to such relationship, and pointed out how Dr. Frankland had clearly shown that the relationship between the members of the paraffin family was a most important one. He (the speaker) tried another family—viz., the unsaturated series in the olefines. He tried to bring in a second member—viz., butylene—and practically he found that there was exactly the same relationship between ethylene and butylene that Dr. Frankland had found between two corresponding paraffins which differed by the same number of atoms of carbon. Butylene had just double the illuminating value of ethylene; for 5 cubic feet of the latter, burning at a certain rate, would give a light of about 70 candles, while butylene had something like double this value—sufficient to establish the principle. Therefore, in any comparison of the lighting value of one hydrocarbon with another, they certainly wanted to know something about the quality, as well as the actual amount, of the hydrocarbon. In coal gas, although the factors were numerous, the general character of the mixture was very uniform. If one took a sample of South Metropolitan Company's gas and that of the Gaslight and Coke Company, the uniformity of composition which was observed was most extraordinary, in spite of what was said about carburetting going on; at least, this was his experience up to the present. So that really he was satisfied that the gases he had examined had been made pretty well in the same way. If one were to carburet hydrogen with carburine, no doubt those conditions would be changed. There were, however, several other important points—and difficult ones—in the very useful paper they were discussing. They had not by any means reached the solution of many of the enigmas Professor Lewes had attacked; but he (Professor Foster) thought that this question of the solubility of one vapour in another was a most important matter, and one which had not perhaps received the attention it deserved.

Mr. N. H. Humphrys (Salisbury) said the members were accustomed to consider in that room the properties of a single gas, or one that was made at a single operation; but it was evident they must extend their observations, and give their attention to what might be called, for distinction, a compound gas, made by an admixture such as that to which Professor Lewes had referred—viz., a poor quality of coal gas and a rich oil gas mixed together. One of the most important features to attend to in doing this would be to see that the gases should be thoroughly mixed; and he was somewhat surprised to learn that, in the small experimental holder, after the mixtures had stood all night, it was necessary to burn out the whole of the gas to get a fair average. Perhaps Professor Lewes would tell them whether, if the gases would not mix in a small holder, they would do so better on a larger scale. This was of some interest, because they knew the standard of light was under consideration, and suggestions had been made in the direction of the arrangement known as the pentane standard, which was what might be called a compound gas, or a small quantity of pentane vapour

diffused through air. It was most important, of course, that this vapour should continue perfectly constant throughout; and he should be glad to have a little more information on this point. Hearing the paper read, he had been reminded of certain experiments shown before one of the Scottish Associations some years ago by Mr. William Young, the results of which appeared in the JOURNAL OF GAS LIGHTING at the time. Speaking from memory, he thought the conclusion Mr. Young arrived at, after experimenting with various samples of gas, was that theoretically the best gas was pure hydrogen, carburetted with benzene; and this seemed to agree very much with the conclusions now put forward.

Mr. W. CARR said that there was one point to which he wished to draw attention before the discussion closed, though he did not suppose it could be dealt with thoroughly that afternoon. If he had understood Professor Foster on the previous day, he laid some stress on the value of carbon density, and intimated that one should judge of the value of a gas by the amount of carbon contained in various forms in the mixture. Now Professor Lewes told them that carburetted hydrogen was of more value than carburetted carbon monoxide, which seemed to be quite contradictory to what he understood to be Professor Foster's contention. If professors differed on these points, there was evidently a great deal to be learnt; and perhaps gas managers were not very much to blame for being so far in the dark as they were, when such differences arose amongst the giants of the profession. He hoped this was a step towards determining what was the real value of an illuminant in any shape or form; and the more they could learn on these points, the better it would be.

Professor FOSTER asked leave to explain that he never attached any great importance to the density of the carbon taken alone. There was the question of hydrogen density, and the total volume of the heavy hydrocarbons in addition. He simply gave a summary of all the forms of carbon in the mixture; but he did not attempt to assess the relative value of each factor in the mixture.

Mr. W. SUGG said, with regard to the question put by Mr. Humphrys, as to whether or not the different portions of the gas in the holder would vary in constitution, he had perhaps forgotten that, in the carburetting process of which Professors Lewes and Foster had been speaking, the intention was that the enricher should be put into the gas as it was being sent out to the public, and not go into the holders at all, which would probably make a considerable difference in the effect.

Mr. HUMPHRYS said his point was that, given a small quantity of oil gas and a large quantity of coal gas admitted into the holder, would they mingle together perfectly, and form one constant mixture, or would they be liable to stratify?

Professor LEWES, in reply, said Dr. Thorne, in opening the discussion, gave some very valuable details, and also a *résumé* of some interesting experiments, made by the Manager of the Cologne Gas-Works, upon benzene as an enricher. Benzene had undoubtedly very great illuminating value; and it was necessary to add much less of it, to gain a certain effect, than of many other compounds. But too much stress must not be laid upon its value, as it could only be used as a vapour, and was therefore liable to condensation with cold. Berthelot showed that a very large percentage of the unsaturated hydrocarbon in coal gas was due to benzene. But the method by which that estimation was made was not one which could give any really sound idea of the volume of benzene vapour present; and from those experiments the amount of vapour of benzene in coal gas was considerably over-rated. The other experiments to which Dr. Thorne had referred were very favourable up to a certain point; but too much importance ought not to be attached to them. No doubt at the present moment they stood very much in need of experiments being made on the enriching powers of benzene and benzol, and the way in which they could be applied. As all present knew perfectly well, certain London Companies were just now really hampered with an excess of the light hydrocarbons obtained in working up their own tar; and if, as was likely to prove to be the case, they could, by certain processes, get a very high illuminating power out of these lighter oils, it would be very much better to utilize them in enriching their gas than allow the market value of these particular residuals to become reduced by forcing them upon it. Mr. Thwaite had made certain remarks upon the manufacture of hydrogen and water gas. He was not aware that that gentleman knew anything about his present apparatus or mode of making hydrogen; and therefore he could not be in a position to discuss the question. He also pointed out that the specific heat of water vapour was very high, which would militate against hydrogen as a fuel gas; but it must also be remembered that with an ordinary gas-flame there was being burnt 50 per cent. of hydrogen. He was not proposing to burn the hydrogen flame by itself, but to utilize it as a diluent for hydrocarbons, so that the mixture could be used for either heating or illuminating purposes—in fact, simply utilizing it in making a mixture of gases as nearly comparable with coal gas as possible; and he believed that, if they wished to enrich gases, this was the true way in which to attack the problem. They knew all about coal gas and its functions; and when they wanted to enrich gases, they should make them as nearly as possible on the lines of the old gas which they had been using, and about which they already knew so much. Professor Foster had pointed out also, with many "ifs," the action of vapours upon some of the hydrocarbons present in a gas-flame. In the last paragraph of his (Professor Lewes's) paper, he would see it distinctly stated that, if the coal gas was enriched by hydrocarbon vapours, especially those derived from American petroleum, and a falling temperature caused condensation, the condensing vapours of the paraffin series brought down with them in solution ethylene, benzene, and others of the most valuable illuminants, amongst the unsaturated hydrocarbons. It would relieve his friend to know that he (Professor Lewes) had been making probably more experiments in that direction than anyone present, and that he knew a little about the subject. In the paper itself, he had really been discussing two points: First, that when one enriched by putting in a vapour, the same amount of vapour went into every gas; so that even if one had a low illuminating power just as much carburetting had to be paid for. Secondly, that one could not calculate the amount of a rich gas necessary to add to a poor gas, without taking into consideration the constituents of the gas to be enriched. Mr. Humphrys was far too good a gas engineer to suppose that, when they came to the enrichment of coal gas by heavy oil gas, they would put a certain percentage of the latter into a large gasholder, and then send the poor coal gas into it. When this form of enrichment was employed, it would either be done by adding the oil gas in small quantities as the gas left the holder, or by (as he should consider a far better method) adding it in small quantities as the gas entered the holder, so as to bring about the combination in a more perfect way. The admixture would not take place in an immense holder, but in the main by which it entered; and, by special methods which could be devised, perfect diffusion would take place sufficiently rapidly over the whole mass to make it a perfect mixture before it entered the holders. His reason for taking all the precautions he had used in these experiments was to avoid certain errors which made themselves very manifest in a good deal of the work on enrichment which had been published. If they took pentane, and put it into air, in order to enrich it for testing purposes, experiment had shown that they could get a perfect mixture in three hours. Tests could be taken from different parts of the holder, and all the way through the result would be constant. It was therefore an absolute necessity, in making the gas, that it should stand for three hours before it could be used as a standard flame. According to the inventor's instructions, the tester should make it at night, and use it the next morning. In any time over three hours, one could rely on having a perfect mixture. Mr. Carr had asked him to explain something about the relation of the carbon densities and the total hydrocarbons in gas as giving a guide to the illuminating value. He was not a believer in finding out the illuminating values from the carbon densities at all. In the first place, several points had to be considered. Looking at one of the tables before them, it would be observed that there was a list of some 15 or 20 hydrocarbons, compiled by several experimenters as being present in coal gas. A number of them were undoubtedly present; but there were not any two in the list which gave the same illuminating value. What was the result? They took a coal gas, analyzed it and found it contained 3·5 or 4 per cent. of unsaturated

hydrocarbons. They then went on with the analysis, and finally came the estimation of saturated hydrocarbons, which 99 analysts out of 100 arrived at by explosion with oxygen. They next took the carbon dioxide formed in the explosion, and calculated out what this would be as marsh gas; and put that in as the volume of marsh gas or methane present in the gas. Any analysis conducted in this way was not worth the paper on which it was written; but 99 per cent. of the analyses had been so conducted. Amongst those saturated hydrocarbons, there was perhaps 80 to 90 per cent. of methane. But they had also 5 to 10 per cent., or perhaps even more, of the higher members of this series of ethane, propane, butane, or even perhaps pentane; and if they had the merest traces of those vapours present, the quantity of saturated hydrocarbons, as calculated from the carbon dioxide resulting from the explosion, occupied a far higher volume than if they had been all methane. Inasmuch as the hydrogen was afterwards found by difference, it was the poor hydrogen which always suffered in the analyses. They had the hydrogen in the analysis lower than it ought to be, and the saturated hydrocarbons far higher; and starting on this false basis, they tried to calculate out from the volumes the ratio of carbon and hydrogen present, without in the least knowing the things with which they were dealing. He could not therefore give Mr. Carr any definite answer on that point. He thanked the members for the way in which the paper had been received, and expressed the hope that they might all meet on some future occasion, and elucidate a great many other points.

PAPERS READ AT THE MEETING.

(*Continued from Vol.* LIX., *p.* 1234.)

THE EXTERNAL VERTICAL STANDARDS OF GASHOLDER FRAMEWORK.

By Arthur T. Walmisley, M.Inst.C.E., of London.

The growth of gasholder construction created by the rapid demands of supply for large areas from central stations, has necessitated their gradual development, from single lifts of a few yards in diameter, to structures of six lifts and of 300 feet in diameter. This development has witnessed the supersession of the separate column system by an exterior braced system of framework, forming a vertical cylinder, in which standards of various forms and sizes have been introduced. The calculation of stresses in such frameworks composing the guide-framing of gasholders, is subject to some unavoidable ambiguity. When the structure is a complex one, the stresses in the separate members forming the cylindrical framework become, to a certain degree, indefinite; but in the investigation of general principles from simple examples, which admit of definite treatment, sufficient may be learnt to direct the designer how to deal correctly with the hypothetical conditions which more complicated examples present.

One of the first questions to be settled is the extent to which the external guide framework shall be called upon to assist the gasholder bell to resist distortion. The answer to this question may suggest consulting some of Mr. Gadd's works—an inquiry beyond the scope of the present paper. But presuming that (1) when external framework is adopted, it is not advisable to reduce the guide-framing, below the upper or inner lift in the position in which the gasholder bell is fully inflated; and that (2), regarding the holder as a floating vessel, any unnecessary additional weight tending to increase the back pressure upon the exhauster should be obviated—the author will, without further preface, proceed to examine some of the leading conditions which affect the form and strength of external standards.

Experience has amply proved that the plating and side stays of a gasholder are more than adequate to resist the internal pressure of the gas under all circumstances; but the moments produced by the external pressures induce strains which it is the object of the outside framework to resist. The comparative resistance of a flat and cylindrical surface to wind pressure is known to be 56 per cent. of that presented by a plane vertical surface of the same height having a width equal to the diameter of the cylinder. The upper projection of the flat domical roof to the bell does not practically affect the result as regards wind pressure. It tends to produce a downward pressure which would be exerted upon the windward side of the holder, accompanied by a certain skin-friction producing a moment in the opposite direction. The diametrical section of the holder representing the gross surface exposed to 56 per cent. of the total lateral wind pressure, will be equivalent in area to a rectangle whose upper edge is a horizontal line drawn at a distance below the crown equal to one-third of the rise of the domed roof. The section of this domed roof will correspond with the arc of a circle, as shown in figs. 1 and 5; the top sheets forming the upper portion of a sphere being constructed upon the theory that any hollow vessel subjected to an internal pressure tends to become a sphere; so that the outer edge of the domed roof being fixed to the top curb of the holder by a sufficiently rigid attachment to provide a substitute for the lower portion of the sphere, uniform strain throughout the crown may be aimed at, together with the provision of a moderately flat top suitable for the position of the holder when at rest in the tank, and access for the examination of its interior.

Working upon the principle that the guide-framing should be self-supporting, and not dependent upon the holder for maintaining its cylindrical form, the author will first consider the simple case of a single-lift holder guided by radial rollers near the top and the bottom of the bell, as in fig. 1. [The figures will be found on p. 23.]

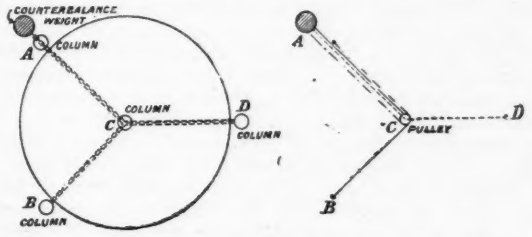
If $a\,b$ represent the horizontal line through the crown above referred to, and x be its variable height above the ground line, while H illustrates its height above the lower tier of rollers, then if D is the diameter of the gasholder, and P = pounds pressure per square foot, the exposed surface is equivalent to $D\,x$, and the wind pressure $W = \cdot 56\ P\ D\ x$, from which it is evident that W varies in amount directly as x. Suppose h equals the total vertical distance between the centres of the upper and lower tiers of rollers, and that h_1 denotes the height of the upper roller above the ground line, and h_2 the depth of the lower roller below the ground line, then the pressure (R_1) produced by the upper roller upon the external support will be—

$$R_1 = \frac{W}{h}\left(h_2 + \frac{x}{2}\right)$$

and at the lower roller, the pressure (R_2) will be

$$R_2 = \frac{W}{h}\left(h_1 - \frac{x}{2}\right)$$

The forces thus obtained are communicated by the gasholder to the guides attached to one or more standards upon the leeward side of the bell; and the distribution of their pressures R_1 and R_2, together with the bending stresses on the several standards, will, of course, depend



upon the arrangement and connection between them. An original form of holder is exhibited in the annexed illustration, in which chains pass round each of three columns from the centre of the top of the gasholder to a counterbalance weight. This primitive method, I am informed, was adopted about the year 1830 at a gas-works in Wales; and it forms the first step towards more perfect systems erected since this early stage.

If, as in fig. 2, we assume the unusual case of a gasholder guided by four standards fixed at the base, and bedded flat to masonry, but not united at the top, the whole of the roller pressure R_1 would be borne by a single standard when the wind blew in the direction of two opposite standards, as indicated by the arrow W. If the lower roller does not rise higher than the ground line, then for any position of the gasholder during its lift, the diagram of moments will always be a triangle (as indicated in fig. 1) whose base M graphically represents the moment $= R_1 h_1$ at a depth below the apex of the triangle $= h_1$. Thus, it will be seen that the moment at the base of the standard increases rapidly with the rise of the

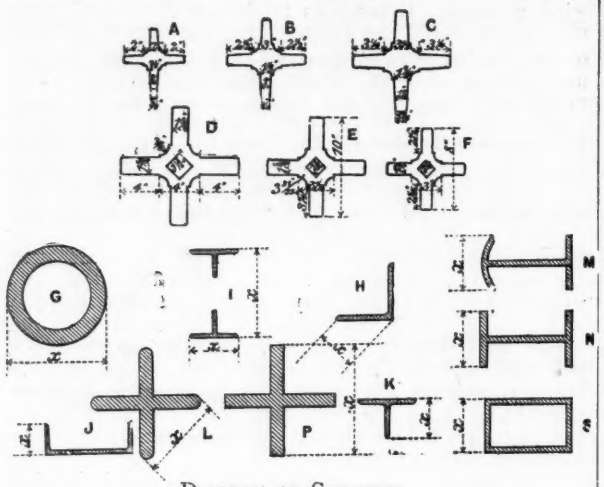


Diagram of Sections.

holder; and hence a developed form of standard, as shown in sections H to L, is preferable to a column (section G) or standard of an unvarying section. The moment attains its greatest value when the holder is up to its full height; and if at this stage we assume the lower roller to be then at the ground line, we have in fig. 1, $H = x$ and $h_1 = h$. In this case the roller pressure becomes $R_1 = W\frac{H}{2h}$; and the maximum bending moment at the base of the standard will be $M = W\ \frac{H}{2} = \cdot 56\ \frac{P\,D\,H^2}{2}$, (because in this case $\frac{h}{2} + \frac{x}{2} = \frac{H}{2}$), and thus we obtain a result $= \cdot 28\,P\,D\,H^2$, which depends solely upon the height of the holder. In the case of a group—say, of 24 standards, more or less, according to the size of the holder—we may suppose for purposes of calculation, that the group can be replaced by two standards situated respectively diagonally opposite one another, at the centre of pressure of the group, or of 12 standards upon either side of the axis of the bell. If the framework were perfectly elastic, the diagonals in direct lines, and the annular stiffness perfect, these centres of pressures could be determined by the radius of gyration of the group of standards (which, in this case, is 0·7071 times the radius); and the distance so obtained, would be applied to obtain mathematically the centres of measurement from the centre of the holder of the centres of thrust and lift respectively, which when found enable us to arrive at the stresses in the bracing, as ably demonstrated upon p. 47 of Mr. F. S. Cripps's treatise on "The Guide-Framing of Gasholders." Assuming the distance between these centres of pressure to be equal to the effective depth of a lateral girder, these centres may be regarded as corresponding with the tensile and compressive flanges of such a girder placed horizontally. If the holder is fitted with tangential, instead of radial, rollers, and that we suppose the tangential rollers to work upon the same four standards, as shown in fig. 2, then the roller pressure R_1 would be equally divided between two opposite standards Nos. 1 and 3 when the wind blew in the direction W; and the maximum bending moment upon either of these standards would be $M = W\frac{H}{4}$. When the wind blows in the direction of the arrow marked F, or of any diametrically opposite pair, two standards would come into play; and when in a diagonal direction with tangential rollers, the four standards would come into play and divide between them the component parallel to the wind's direction. Thus when the arrow F, in fig. 2, making an angle of 45° with the axis joining (say) standards Nos. 1 and 3, indicates the prevailing wind, the moment for each standard becomes $M = \frac{WH}{4} \times \frac{1}{\sqrt{2}}$ assuming the four standards to be of equal stiffness and all the rollers to be simultaneously in contact with the guides. It is, however, to be noted that, whenever the wind pressure is sustained by more than two standards, the exact distribution of the stress between them will depend upon the perfect adjustment of rollers and guides, as well as upon the relative stiffness of the standards in the plane of their actual deflection. The relative deflections of the several standards may be easily arrived at by calculation, and their reactions in opposition to wind-pressure summated, if we suppose the reaction of the guide upon the roller to act in a direction perpendicular to the guide-face, whether radially or tangentially exerted, and assume that the deflection of the standard takes place in the opposite direction.

The author will assume a case with eight standards and radial rollers, as shown in fig. 3. The deflection of the standards will be in a radial direction. Suppose the standards are of equal stiffness, and spaced at equal distances apart, and the wind blows in the direction of the arrows marked W (fig. 3). Owing to the direction in which deflection takes place, we may neglect the consideration of any lateral friction between roller and guide, with the use of radial rollers; and reference to fig. 3 will show that the only standards which come into play will be those to leeward of the transverse diameter joining standard No. 1 with standard No. 5—namely, Nos. 2, 3, and 4. Then if θ denotes the angle of any radial line, as that drawn from C through No. 4, with the direction of wind-pressure, the radial reaction of the elastic standard No. 4 will have a component parallel to the direction of the wind—that is, in a line joining C with standard No. 3. The magnitude of this component will be proportional to the square of the cosine of the angle at the centre C subtended by these standards, which in the present instance is 45°. It is assumed that the rollers are adjusted to touch the standards Nos. 2, 3, and 4 simultaneously, and that the roof of the holder keeps the rollers rigidly in position; so that, while the standards deflect in a radial direction, the gasholder and its circle of rollers moves in the direction of the wind. The oblique rollers will undergo a small sliding motion in the direction of their axis—either by sliding on their spindles or sliding of spindles in bearings, or else of rollers on paths. Referring to fig. 4, if A B represents the motion of every roller in the direction of wind pressure, the radial deflection of the standard will be E B = A B cos θ. The radial reactions of the several standards will be proportional to their deflections E B; but these reactions can be resolved into E D and D B, of which the former (E D) is balanced by the similar side-pressure of the corresponding roller upon the other side, while the pressure D B, in direct opposition to the wind force, will be D B = E B cos θ = A B cos^2 θ. Hence if R_r denotes the direct reaction of the standard No. 3, the reaction of the standard No. 4, in opposition to wind pressure, will be $R_r \cos^2\theta$. With the adoption of eight standards, as in fig. 3, $\cos 45° = \frac{1}{\sqrt{2}}$; and $\cos^2\theta = \frac{1}{2}$. Therefore, the roller pressure distributed upon the leeward standards will be $R_r = \frac{R_1}{1 + \frac{1}{2} + \frac{1}{2}} = \frac{R_1}{2}$, and the base of standard No. 3 should be calculated to sustain a bending moment of $\frac{W}{2h}\left(h_2 + \frac{x}{2}\right)$.

The foregoing considerations are based, as previously stated, upon the hypothesis that each standard acts as a cantilever fixed at the base, and that the standards are not united at the top. If they are connected by a ring attached at their upper ends, the standards which appear to be most heavily strained, will derive some support from the others; and the latter will in some degree be pulled over along with the leeward columns. But the extent to which the stresses would be influenced depends on the comparative stiffness, or relative yield, of the ring and of the standards respectively. When the horizontal ring connecting the top of the standards—whether assisted by Paddon's wind ties or not—possesses sufficient rigidity to maintain the top of the standards in a true circle, and the standards themselves are securely fixed at the base, they may be calculated as columns fixed at one end, and imperfectly fixed at the other; while if the ring is very yielding as compared with the stiffness of the standard, the stresses will approximate more closely to the calculations already made, as illustrated in figs. 1 and 5.

To illustrate the two extreme cases, the author will take first the eight standards shown in fig. 3, made deep and stiff in a radial direction, and suppose them to be united at the top by a narrow circular ring, possessing little resistance to distortion and therefore permitting the tops of standards Nos. 2, 3, and 4 to spread outwards by tending

to straighten into a polygonal form. On the other hand, if we assume the columns to be comparatively slender, and the ring very rigid, the entire ring would move with the top of the holder in the direction of the arrows W (fig. 3) without changing its form, to such a small distance as the elasticity of the standards may allow. The latter event may occur if the ring be made of great width and stiffness, or if made of polygonal form with radial spokes across the top, or by making it polygonal and considering the roof of the gasholder to take the place of the radial spokes, which it will do if the upper rollers are raised to the level of this ring. Whatever the lateral distance moved by the ring in this way might amount to, it would affect every standard in the framework, and would take place in the direction of the arrows marked W, or in the direction of the prevailing wind pressure; and the relative stiffness of the several standards would depend upon the resistance they were capable of offering in a direction parallel to the arrows W. The latter considerations materially affect the calculation of the bending stresses in individual standards.

In the case of a circular column (section G), the stiffness will be the same in all directions; and the bending moment will be the same in each of the eight standards. Thus, if the ring is attached at a height above the ground-line equal to h_1 in fig. 1, and the gasholder be assumed to be raised until the upper rollers come to the same height, the bending moment at the base of each column will be $M = \frac{W H}{2} \times \frac{1}{8} = \frac{1}{16} W H$.

If sections of ⊢ shape be substituted for a circular column, and the depth of the rolled or open section be placed radially with the holder, as in fig. 3, it becomes necessary to calculate the stiffness of each standard in the plane indicated by the direction of the arrows W (fig. 3) or the moment of inertia of each section reckoned about an axis parallel to the line uniting the opposite standards Nos. 1 and 5; and to take the sum of all these moments. If I_1 denote the moment of inertia in either standards No. 7 or No. 3, and I = the sum of all the moments found (as shown on page 43 of Mr. Cripps's book, before alluded to), then the greatest bending moment in any of the standards will be $M = \frac{WH}{2}\left(\frac{I_1}{I}\right)$. Or, again, if the conditions are changed by employing standards of lattice construction as shown in section I, or with tapering depth or variable width of section, the deflection of each standard in the direction of the arrows W (fig. 3) under a unit roller pressure applied in that direction at the top of the standard, should be calculated. If δ denotes that deflection for any given standard, then the force necessary to produce unit deflection in that standard may be denoted by $r = \frac{1}{\delta}$, since $r\,\delta$ is assumed equal to unity. The combined reaction of all the standards for unit deflection will be the sum of these quantities, or $\Sigma\, r$. Now if r_1 denote the quantity r for the case of the standards No. 7 or No. 3, then the bending moment at the base of either of the last-named standards should be calculated as $M = \frac{WH}{2}\left(\frac{r_1}{\Sigma\, r}\right)$.

With the adoption of telescopic gasholders, an additional set of arguments have to be considered. Fig. 5 illustrates a double lift; and as a triple lift may be treated in a similar manner, the author will rest content with the example of a two-lift telescopic holder.

In fig. 5, let D_a and D_b represent the diameters of the upper and lower lifts respectively; while H_a and H_b are their total effective heights—H_b being measured between centres of the rollers attached to the lower lift. The rollers may be designated as Nos. 1, 2, and 3 beginning from the top; and the corresponding roller pressures as R_1, R_2, and R_3 respectively. If h_b represent the height above the ground-line to the upper roller of the lower lift, and h_a the further height from the last-named roller to the upper roller of the top lift at its full height, then the total wind-pressure upon the upper lift will be $W_a = \cdot 56\, P\, D_a H_a$; and, assuming the telescopic holder to consist of two independent tubular girders, free to take an angular motion at the cup, the wind-force W_a will produce a roller pressure $R_1 = W_a \frac{H_a}{2 h_a}$, and will impose upon the second roller a pressure equal to $W_a\left(1 - \frac{H_a}{2 h_a}\right)$. When the second lift in its ascent rises to any given height, h_b, above the ground-line, it experiences the further wind-pressure $W_b = \cdot 56\, P\, D_b\, h_b$; and upon the same assumption as before, this wind-pressure produces a roller pressure $R_3 = W_b \frac{h_b}{2 H_b}$, while it evidently imposes a pressure upon the second roller equal to $W_b\left(1 - \frac{h_b}{2 H_b}\right)$. Thus the total roller pressure at R_2 will become

$$R_2 = W_a\left(1 - \frac{H_a}{2 h_a}\right) + W_b\left(1 - \frac{h_b}{2 H_b}\right);$$ see fig. 5.

If the gasholder, in rising to its full height, brings the third roller up to the ground-line, then we shall have $h_b = H_b$; and the maximum roller pressures will be as follows:—

$$R_1 = W_a \frac{H_a}{2 h_a}$$

$$R_2 = W_a\left(1 - \frac{H_a}{2 h_a}\right) + \frac{W_b}{2}$$

$$R_3 = \frac{W_b}{2}$$

Such forces are applied to the gasholder by guides attached to one or more standards; and their actual distribution depends upon the arrangement of the standards.

In the event of a two-lift holder being guided by only four standards (as in fig. 2) having radial rollers, the whole pressure may come on a single standard; and the diagram of moments will be represented by a bent line, as shown to the right of fig. 5, where M_b = the moment at the base of the standard, and M_a = the moment at the level of the middle roller, while the apex of the figure occurs at the level of the top roller. Between these ordinates to a vertical line, the figure consists theoretically of straight lines, and to construct the diagram we have—

$$M_a = R_1 h_a = W_a \frac{H_a}{2}$$

$$M_b = R_1 (h_a + h_b) + R_2 h_b$$

$$= W_a \frac{H_a}{2} + h_b\left(W_a \frac{H_a}{2 h_a} + \frac{W_b}{2}\right)$$

The results so obtained hold good upon the assumption that the telescopic holder may be considered as a pair of independent girders whose ends rest freely upon the middle roller; and this assumption may be realized in practice if the middle rollers are adjusted in true line with the top and bottom rollers, while the lower lift hangs freely upon the cup joint. If this is so arranged, it is probable that a minute irregularity in the face of the guide, or a minute deflection of the standard, may be compensated for by a slight lateral translation at the joint, and without angular movement.

If the circumstances are such that the parts cannot thus adjust themselves except by an angular motion at the cup-joint, then such angular motion can not transpire except by the imposition of a considerable bending moment upon the gasholder, which action might be sufficient to open the cup-joint upon one side, leaving the weight of the lower lift hanging upon the cup at the other side. The value of this moment may be expressed in terms of the weight of the gasholder; and the roller pressures that would then take effect, either with or without lateral wind-pressure, may be determined in the following manner, and illustrated by fig. 5:—

Let Z_a = the weight of the upper lift
Z_b = the weight of the lower lift
and $Z_a + Z_b = Z$ = the whole weight of the gasholder, which is here supposed to be without counterbalance. If the guides are truly vertical, as also the axis and sides of the gasholder, and the rollers fixed truly concentric with the cylindrical surface, so that their outer edges are at a uniform distance from the axis of the holder, but that the plane of one of the cup edges happened to be left slightly out of right angles to the axis, then the two lengths could not hang together in a straight line unless forced into that position by opening the cup-joint at one side, thus leaving the lower lift supported at the opposite side only. The left-hand side of the upper lift in fig. 5 may be supposed to drop, and the right-hand side rise. The value of this supporting force will depend mainly

upon the difference between the diameters of the upper and lower lifts; and its exact value, represented by S, will equal $Z\frac{D_a^2}{D_b^2} - Z_a$. This equation is derived simply from the consideration that the supporting force consists of the internal gas pressure acting over the whole area $D_b^2 \times \frac{\pi}{4}$; and if the diameter of the lower lift is considerably greater than that of the upper lift, the annular area will take a portion of it, while the fraction of the whole supporting pressure taken by the upper lift will be—

$$= \frac{D_a^2 \frac{\pi}{4}}{D_b^2 \frac{\pi}{4}} = \frac{D_a^2}{D_b^2}.$$

And if Z = the whole weight, or whole supporting force, the value of that fraction will be $Z\frac{D_a^2}{D_b^2}$. Hence if Z_a is the actual weight of the upper lift, the unbalanced residue will be $Z\frac{D_a^2}{D_b^2} - Z_a$, which represents the actual load upon the edge of the cups. An expression might have been obtained in a similar manner in terms of the weight of the lower lift, annular area, &c.; but it would have been less simple. Referring to fig. 5, in order to keep the floating gasholder in equilibrium, the roller pressures as applied should equal the following values under the above conditions (the radius of the bearing edge being taken equal to r as shown in the figure):—

$$R_1 = S\frac{r}{h_a} = \frac{r}{h_a}\left(Z\frac{D_a^2}{D_b^2} - Z_a\right)$$

$$R_2 = S\frac{r}{H_b}$$

$$R_3 = R_1 + R_2$$

These roller pressures are, of course, independent of wind-pressure. But they are important to consider; because they might be called into action by imperfect adjustment, or by any tendency to error of adjustment likely to create a similar effect. The particular error above alluded to, is selected by the author, as a type of many others, some of which are dealt with in Mr. Cripps's treatise under the head of racking forces. The same event might transpire in various ways, such as the tendency of a slender standard to warp by changes of temperature.

It will be obvious that if a wide amount of play is allowed in adjusting the rollers between opposite guides—say, between Nos. 7 and 3 of fig. 3—the gasholder might have sufficient room to hang in its natural position, without opening one side of the cup-joint, even if the plane of the cup-joint happened to be slightly oblique. But if the adjustment is effected by opening the cup-joint at one side, the three rollers would become out of line, and only two might remain in contact with the guide upon either side. A wind force acting in the direction indicated by the arrows in fig. 3 would, in this case, have to be resisted by roller pressures at the top and lower tier of rollers in fig. 5; and the values of R_1 and R_3 respectively would be—

$$R_1 = \left\{W_a\left(H_b + \frac{H_a}{2}\right) + W_b\frac{H_b}{2}\right\}\frac{1}{h_a + H_b};$$

while $R_3 = W_a + W_b - R_1$.

The diagram of moments would be a triangle; and the moment at the base of the standard would be $M = R_1(h_a + h_b)$. These formulæ would apply so long as the gasholder retained this assumed crooked condition, or until the wind-pressure rose to such an intensity as to open the cup-joint upon the windward side and force the holder into a straight line against the leeward guide—No. 3 of fig. 3—a condition which would alter the roller pressures to the values previously stated for R_1, R_2, R_3, where S, the value of the supporting force, and r, the radius of the bearing edge, is introduced into the equation.

Again, if we suppose the work adjusted to a closer fit, so as to allow only a very small amount of play between the rollers and the opposite guides—Nos. 7 and 3 of fig. 3—then any considerable obliquity of the cup-joint might render it impossible for the holder to hang evenly upon the cup-bearing, and the joint is compelled to slightly open on one side or tend to do so; and if we suppose the wind pressure to act in the direction shown in fig. 3, with an intensity less than would be sufficient to open the cup-joint, then the roller pressure R_2 at the standard No. 3 would be diminished by the action of the wind and will have the value—

$$R_2 = \left(Z\frac{D_a^2}{D_b^2} - Z_a\right)\left(\frac{r}{h_a} + \frac{r}{H_b}\right) - \left\{W_a\left(1 - \frac{H_a}{2h_a}\right) + \frac{W_b}{2}\right\}$$

Such an expression indicates approximately the conditions under which the gasholder would be straightened up by the wind-pressure, and would occur when—

$$W_a\left(1 - \frac{H_a}{2h_a}\right) + \frac{W_b}{2} = \left(Z\frac{D_a^2}{D_b^2} - Z_a\right)\left(\frac{r}{h_a} + \frac{r}{H_b}\right)$$

or when R_2 = zero in the above formula.

For any smaller wind pressure, the roller pressures R_1 and R_3 in the case before us would remain unaltered—

$$R_1 = \left(Z\frac{D_a^2}{D_b^2} - Z_a\right)\frac{r}{h_a}$$

$$R_3 = \left(Z\frac{D_a^2}{D_b^2} - Z_a\right)\frac{r}{H_b}$$

These expressions give also the roller pressures R_1 and R_3, which would take effect in any case in which the three rollers are out of line when the wind is just sufficient to straighten the holder against the leeward standard. If the wind pressure were ever more than sufficient to do this, it would tend to produce a roller pressure R_3 upon the leeward guide, and the several forces would then be as follows:—

$$R_1 = W_a\frac{H_a}{2h_a} + \left(Z\frac{D_a^2}{D_b^2} - Z_a\right)\frac{r}{h_a}$$

$$R_2 = W_a\left(1 - \frac{H_a}{2h_a}\right) + \frac{W_b}{2} - \left(Z\frac{D_a^2}{D_b^2} - Z_a\right)\left(\frac{r}{h_a} + \frac{r}{H_b}\right)$$

$$R_3 = \frac{W_b}{2} + \left(Z\frac{D_a^2}{D_b^2} - Z_a\right)\frac{r}{H_b}$$

Referring to fig. 3, suppose now that the wind blows in the direction of the standards from No. 3 towards No. 7, with the existence of the loose-fitting adjustment above described, then the holder will press against the guide No. 7 mainly at the second or middle roller, upon which it will ride as on a fulcrum, and will tend to bring either the top or lower roller into contact according to the balance of the wind-pressures above and below that fulcrum. This consideration will suffice to determine the roller pressures for any given wind-pressure, until such pressure is sufficient to open the cup-joint upon the leeward side, and thus to straighten the holder against the guide.

Next let us suppose that the rollers are fitted with a minimum amount of play, and that while the wind is blowing contrary to the direction of the arrows W in fig. 3—*i.e.*, from standards No. 3 to No. 7—that the joint is forced slightly open upon one side, due to the impossibility of the holder hanging evenly upon the cup-bearing. Then, without any wind pressure, the roller pressure at the second roller is found to be—

$$R_2 = \left(Z\frac{D_a^2}{D_b^2} - Z_a\right)\left(\frac{r}{h_a} + \frac{r}{H_b}\right);$$

and the action of the wind will not increase this pressure until the wind-pressure is sufficient to straighten the holder by overcoming the moment $\left(Z\frac{D_a}{D_b} - Z_a\right)r$.

The wind pressure W_a will, however, reduce the original roller pressure R_1 which in the absence of wind-pressure had the value $R_1 = \left(Z\frac{D_a^2}{D_b^2} - Z_a\right)\frac{r}{h_a}$; and its value will be

$$R_1 = \left(Z\frac{D_a^2}{D_b^2} - Z_a\right)\frac{r}{h_a} - W_a\frac{H_a}{2h_a}$$

But when the wind pressure is sufficient to make the moment $W_a\frac{H_a}{2}$ equal to the moment $\left(Z\frac{D_a^2}{D_b^2} - Z_a\right)r$, the upper length will tend to take a bearing upon the top roller upon the leeward side, instead of upon the windward side. It is evident that the lower lift will be influenced by a similar balance of forces, the particulars and moments of which need a similar investigation.

When the wind pressures W_a and W_b are in excess of the values indicated above, then we shall have the following roller pressures on the standard No. 7 of fig. 3, which shows the wind blowing in the direction of the standard

No. 3 towards No. 7, or contrary to the arrows W shown in fig. 3, with the use of a holder as in fig. 5—

$$R_1 = W_a \frac{H_a}{2h_a} - \left(Z \frac{D_a^2}{D_b^2} - Z_a\right) \frac{r}{h_a}$$

$$R_2 = W_a \left(1 - \frac{H_a}{2h_a}\right) + \frac{W_b}{2} + \left(Z \frac{D_a^2}{D_b^2} - Z_a\right) \left(\frac{r}{h_a} + \frac{r}{H_b}\right)$$

$$R_3 = \frac{W_b}{2} - \left(Z \frac{D_a^2}{D_b^2} - Z_a\right) \frac{r}{H_b}$$

At the base of the standard, the bending moment becomes $M = R_1 (h_a + h_b) + R_2 h_b$.

Finally, the above-named considerations may be applied in the case of a telescopic holder, where the top length is allowed to rise above the guide-framing, or under circumstances where the uppermost rollers become, from any cause, inoperative. Let us assume we have to deal with a double-lift holder, in which the wind-pressure can only be resisted by the second and third rollers of fig. 5 attached at the top and bottom of the lower lift. The wind-pressures upon the upper and lower lengths become, as before, $W_a = \cdot 56\, P\, D_a\, H_a$ and $W_b = \cdot 56\, P\, D_b\, h_b$. The pressure W_a will exert a moment about the cup-joint equal to $W_a \frac{H_a}{2}$; and the joint will not open unless this moment is equal to $\left(Z \frac{D_a^2}{D_b^2} - Z_a\right) r$, or, in other words, until the wind pressure per square foot amounts to $P = \frac{2r\left(Z \frac{D_a^2}{D_b^2} - Z_a\right)}{\cdot 56\, D_a H_a^2}$

If we assume, as in the case of a very large holder, the difference between D_a D_b and $2r$ may be inconsiderable as compared with the mean diameter D, then the above expression may be modified to give an approximate result; and it becomes $P = \frac{Z_b}{\cdot 56\, H_a^2}$, in which Z_b is the weight of the lower lift. For any wind-pressures less than this, the roller pressures will have the following value, when the lowest roller rises to the ground level :—

$$R_2 = W_a \left(1 + \frac{H_a}{2\, H_b}\right) + \frac{W_b}{2}$$

$$R_3 = \frac{W_b}{2} - W_a \frac{H_a}{2\, H_b}$$

The last expression for R_3 may be either positive or negative. If $\frac{W_b}{2}$ is greater than $W_a \frac{H_a}{2\, H_b}$, the roller pressure at the base of the holder is positive, and takes effect on the leeward side; but if the contrary is the case, then the negative value implies that the roller pressure R_3 takes effect upon the guide on the windward side.

The case of a triple-lift holder, under similar circumstances, can be argued upon the same principles. Thus it will be seen that, when the external vertical standards of a framework are individually considered, the columnal system is not theoretically so applicable a section as the more developed systems; but that when the standards are made in separate parts as in the case of columns bolted one upon the top of another at their intersection with the lateral girders, or when, as with the use of Cutler's complete cylindrical system of framework, each upright forms a strut of short length in a braced framework, as explained in the author's paper of 1891, then the most rigid form of strut to resist both crushing and flexure should be introduced.

Hence a paper of this description would be incomplete if it did not elicit some discussion upon the strength of struts which form the compressive members in the framework of a gasholder. We know that a strut may fail either by crushing or by bending, or by the combined effect of crushing and bending. A cubical block evinces no tendency to fail by crippling or buckling; it fails by crushing. It cannot practically be bent. But increase the height to twenty times the lateral dimensions, and it becomes a pillar having other functions to perform besides supporting a weight or resisting side pressure, as it will be called upon to resist flexure and may fail by crippling or buckling even when the load applied is less than that required to crush the same sectional area in a short height. To render this intelligible, as well as to argue what is the nature of the resistance a long pillar will offer to a bending force, let us assume the case of a slender rod with rounded or hinged ends, which is caused by outside influences to bend like a bow, assuming a curvature X Z Y, as shown in fig. 7. The action is the same as in the case of a bow united by a string or chord line X Y; and the limit of lateral deflection depends upon the elastic stiffness of the material, and upon the dimensions of the pillar or strut. In practice the tendency to buckle is resisted by internal bracing (see fig. 8); and thus by a development of the amount of metal employed (as in a lattice girder), we can in construction obtain a strut stiff enough to sustain its load without crippling. Under ordinary circumstances in a strut this load is applied upon the head of the pillar; but in the case of gasholder standards braced one to another by girders and diagonal ties, the load is applied transversely to the standard. Fig. 8 illustrates, by the letters *x m n y*, the bending action under a vertical weight when the ends are rigidly fixed and flat, the standard being adapted to a fixed base by the addition *y n k*; but if the ends be supposed to be imperfectly fixed, or free to turn in their bearings, then under the influence of stress uniformly distributed over the sectional area of the pillar, the maximum lateral deflection will be in the centre of the length, and may be supposed to be measured from the chord-line to the centre of either the tensile stresses in the convex or to the centre of the compressive stresses in the concave side of the specimen.

If F = the force in the direction X Y, applied either as a chord to a bow or as a vertical weight upon the head of the strut, then $F = I \times \frac{8E}{l^2}$, in which I = moment of inertia of the section, E = the modulus of elasticity, and l = the length of the pillar.* The moments of inertia for beams of various sections are given in "Molesworth," p. 123 † Hence for long, solid, rectangular pillars, with ends hinged, we have, $F = \frac{8E}{l^2}\left(\frac{b d^3}{12}\right) = \frac{2E\, b\, d^3}{3\, l^2}$. For long solid round

* Assume the curve of deflection to be a circle, from which it can differ but slightly. If d = the diameter or least lateral dimension of the pillar, l = the length of the pillar; and λ = the difference in length between the convex and concave sides of the pillar after deflection. Then if we suppose that, by some means, the pillar is bent until the lateral deflection at Z = Δ, and that the bending is resisted by forces acting vertically at X and Y, it can easily be shown that $\Delta = \frac{\lambda l}{8d}$; and this value will become useful in estimating the tension on the chord-line X Y.

Since the deflection is very small compared with the radius of curvature, we may assume C B to be equal to the radius C X or C Y, and the chord-line X Y = X Z Y = l. Whence, by Euc. III., 35, we can equate referring to fig 7.

$(R d + C B)\lambda = (X B)(B Y)$ or $2 R \Delta = \frac{l}{2} \times \frac{l}{2}$ or $\Delta = \frac{l^2}{8R}$.

Since the portion of length λ may be assumed to be cut off by an edge parallel to the edge at Y, we have by similar triangles $R : l :: d : \lambda$; and hence

$R = \frac{d\, l}{\lambda}$. Whence, by substitution, $\Delta = \frac{\lambda l}{8d}$ approximately.

Again if M = the moment of resistance of the longitudinal elastic stresses or moment of rupture, and F = the vertical force as applied in the line X Y, then $M = F \Delta$. Combining the two above results, we obtain $F = \frac{M\, 8d}{\lambda l}$ But λ is equal to the contraction of the concave edge *plus* the extension of the convex edge of the pillar; and since we know that if a bar whose length = l, be extended or compressed within the limits of elasticity by a stress f lbs. per square inch, the increment or decrement of length λ^1 is expressed by the equation $\frac{\lambda^1}{l} = \frac{f}{E}$. Whence $\lambda^1 = \frac{f l}{E}$; and we thus obtain a value for the elongation in our equation in terms of the range of elasticity $\lambda = \frac{2fl}{E}$. Substituting this in our previous equation $F = \frac{M\, 8d}{\lambda l}$ we obtain $F = \frac{4\, d\, E\, M}{f l^2}$. The value of M to be employed in this equation is obtained from the moment of inertia of section (see "Molesworth," page 123); for if d = the diameter or least lateral dimension of the section, and h = a known distance in the section either above or below the neutral axis of fibres exerting a unit stress of f lbs. per square inch, then in the present case $h = \frac{d}{2}$; and $M = \frac{I f}{\frac{1}{2} d}$. Hence $F = \frac{4 d E}{f l^2} \times \frac{I f}{\frac{1}{2} d} = \frac{8E}{l^2} I$.

† The value of V. in this table simply consists of the moments of inertia divided by $\frac{D}{12}$, or by dividing by the depth in feet. Thus in the case of a rectangular beam

$$I = \frac{D}{2} \times \frac{2D}{3} \times B \times \frac{D}{4} = B\, D^2 \times \frac{D}{12}$$

$$I = \frac{B D^3}{12} \qquad V = B D^2$$

The object is to accommodate the formula given for beams as rectangular girders to beams of various sections by comparing "Molesworth," pages 122 and 123.

pillars, with ends hinged, $F = \frac{8\,E}{l^2}\left(\frac{\pi}{4}\,R^4\right) = \frac{\pi\,E\,D^4}{8\,l^2}$. For long hollow round pillars, where D = the external diameter and d = the internal diameter; ends hinged, we have

$$F = \frac{8\,E}{l^2}\left(\frac{\pi}{4}\left\{\frac{D^4 - d^4}{2^4}\right\}\right) = \frac{\pi\,E\,(D^4 - d^4)}{8\,l^2}$$

The above formulæ—sometimes spoken of as Euler's formulæ—are often quoted as $F = I\frac{\pi^2\,E}{l^2}$; because π^2 or 9·86 is near enough for approximate accuracy. The arguments contained in the first foot-note to the previous paragraph show that the formulæ can scarcely apply to independent columns; the pillar being assumed as a long slender section.* But as struts in a braced framework in which the tension members assist stability, and in which the ends may be regarded as insufficiently fixed to be theoretically rigid, the formulæ will apply. This is practically the case in open lattice standards. It is to be observed, as pointed out by "Stoney," Art. 359, p. 399, that "the longer the pillar is in proportion to its diameter, the closer will the above equation represent the truth."

Mr. J. T. Hurst has worked out a table for cast-iron solid columns flat or firmly fixed at both ends, which is published in "Molesworth's Pocket Book," p. 113 (22nd edition, 1888), calculated by Hodgkinson's formula as expressed by him in the "Philosophical Transactions of the Royal Society" (May 14, 1840), and given in "Molesworth," p. 111, as

$$W = 44{\cdot}16\,\frac{D^{3{\cdot}55}}{L^{1{\cdot}7}}$$

where W = breaking weight in tons
L = length of column in feet
D = diameter in inches.

The value of the powers of D for ready use are approximately given for diameters from 3 to 24; and the value of the powers of L for certain lengths from 5 to 50 feet are also given on page 111 of "Molesworth," and may be proved by logarithms. When the length is less than 30 times the diameter, experiment shows that the correction

$$W = \frac{S\,C}{10\,S + \frac{3}{4}\,C}$$

must be applied, in which S = the strength for long columns arrived at by working out the formula $44{\cdot}16\,\frac{D^{3{\cdot}55}}{L^{1{\cdot}7}}$; and C = 49 times the sectional area of the metal in square inches—49 tons per square inch being, according to "Rankine's Civil Engineering," 18th edition, 1891, p. 236, the ultimate crushing strength of a short block of the same sectional area. Hurst's table being calculated upon the supposition that all are long columns in which the breaking weight is a considerable proportion of that necessary to crush the column by splitting rather than by bulging, the results are stated in the table to allow a factor of safety of 10. The above formula, though the one generally employed, because found in "Molesworth," has been superseded by a later one based on experiment, also made by Hodgkinson about the year 1856, in which he takes $W = 42{\cdot}3\,\frac{D^{3{\cdot}5}}{L^{1{\cdot}69}}$, or approximately $42\,\frac{D^{3{\cdot}5}}{L^{1{\cdot}6}}$. The real strength is probably inversely as $L^{1{\cdot}4}$, or some lesser power of the length, as Mr. Hurst has shown in the case of wood columns in his edition of Tredgold's Carpentry. For hollow columns, as stated in "Molesworth," p. 113, their strength nearly equals the difference between that of two solid columns, the diameters of which are equal to the external and internal diameters of the hollow one. Hence for a hollow cylinder of cast iron, both ends flat, when L exceeds 30 D

$$W = 44{\cdot}34\,\left(\frac{D^{3{\cdot}55} - d^{3{\cdot}55}}{L^{1{\cdot}7}}\right)$$

The figures 42 or 42·3, 44·16 or 44·34 represent average tons weight varying with the quality of the cast iron in a specimen, 1 foot long and 1 inch diameter, experimented upon when well bedded or firmly attached at both ends. Some authorities prefer to give the result in pounds. Thus 44·3 × 2240 = approximately 100,000 lbs. The employment of pound units, as adopted by Rankine, is also very noticeable in translations from German works. Most English engineers, however, prefer to speak of, and work with the unit of tons. Stoney adopts the coefficient 42·6, $D^{3{\cdot}5}$, $L^{1{\cdot}68}$. He gives the values of $D^{3{\cdot}5}$ for diameters varying from 1 to 12, increasing by additions of 0·25 or quarter units, and the values of $L^{1{\cdot}68}$ for lengths varying from 1 to 24, increasing by whole units, upon pages 408 and 409 of his revised edition of 1886; but, in applying the result so obtained when it is required to determine the ultimate strength of medium pillars whose lengths are less than 30 diameters both ends flat and fixed, states it is, however, doubtful whether the following formula is reliable for pillars much less than 25 diameters in length (Art. 375, p. 410).

$$W^1 = \frac{WC}{W + \frac{3}{4}\,C}$$

where W = breaking weight in tons of a column over 30 diameters in length
W^1 = corrected breaking weight in tons of a column less than 30 diameters in length
C = 49 tons per square inch × sectional area in square inches

In Hurst's "Surveyor's Handbook," we find the table for long columns calculated by the formula $44{\cdot}16\,\frac{D^{3{\cdot}55}}{L^{1{\cdot}7}}$; and the table for short columns by Gordon's formula, originally suggested by Tredgold, is deduced from Hodgkinson's experiments in the following manner:—

If P = ultimate resistance to crushing of a block in tons per square inch which is too short to fail in any way by flexure
r = ratio of length to diameter = $\frac{L}{D}$ (both being in same units of measurement)
b = a constant which is equal to k in "Molesworth," p. 114.
f = breaking unit strain of the given section, in tons.
Then

$$f = \frac{P}{1 + b\,r^2}$$

The value of P varies. Rankine (p. 236) gives P = 49 tons per square inch; other authors give less (or 80,000 lbs. = 35·71 tons). The constant b also varies according to different authors; and the only way to reconcile their various results in determining safe loads is to assume that they recommend different factors of safety; or more probably that each allows different values of the factor P.

While for cast-iron cylindrical pillars Molesworth gives b = ·0025 or $\frac{1}{400}$ (Wray and Hurst stating the same), we find Rankine, p. 237, gives $\frac{1}{800}$; and Trautwine $\frac{1}{600}$. Stoney also gives $\frac{1}{400}$. We are supposing in the above that the pillar has both ends fixed by having a flat capital and bases both well bedded or rigidly attached. But if both ends be jointed or imperfectly fixed, then it being found by experiment that a long uniform pillar with ends firmly fixed has the same power to resist breaking as a pillar of the same diameter and half the length with ends free, the ratio in the latter case will equal $2r$; and the formula becomes modified to

$$f = \frac{P}{1 + b\,(2r)^2}, \text{ or } f = \frac{P}{1 + 4\,b \times r^2},$$

in which case the constant b has to be multiplied by 4.

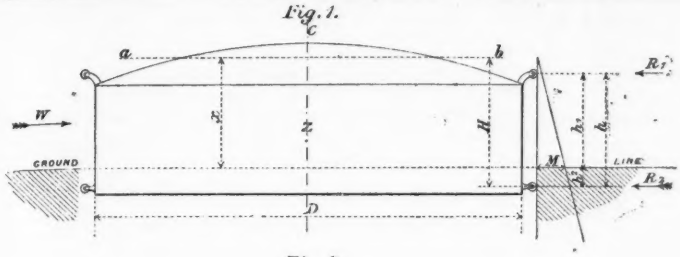
In applying Gordon's formula to a circular column, the diameter is the same in whatever direction a tendency to flexure is assumed to transpire. But with other sections the least width, or the width in the direction of flexure, must be taken for the dimension of d, in the formula. The strength of those with one end flat or fixed and the other end rounded or hinged, is generally assumed to be about an arithmetical mean between the two cases (Stoney, Art. 364, p. 403); but Molesworth (p. 112) also gives the relative strength of round and flat ends in long standards thus—

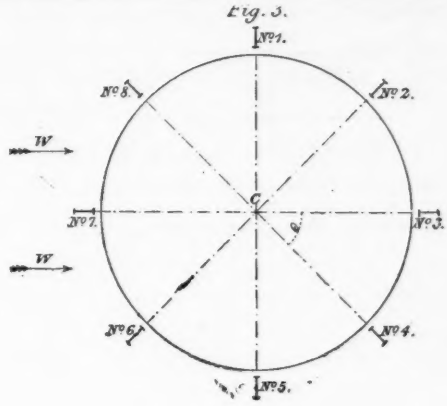
Both ends rounded, 1 strength = 1
One end flat and firmly fixed, 1 strength = 2
Both ends flat and firmly fixed = 3

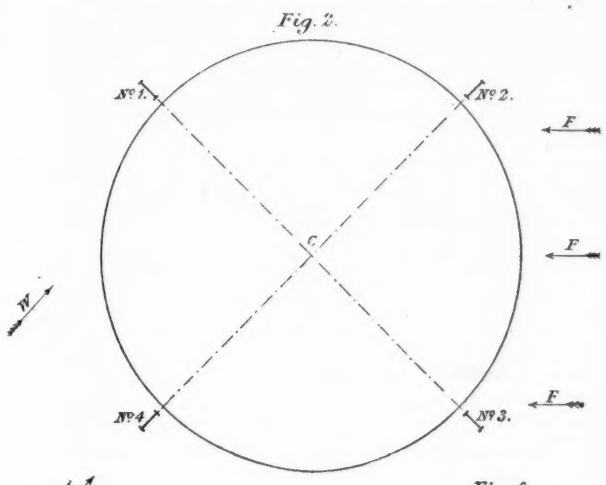
Generally speaking, a long pillar with both ends rounded or imperfectly fixed, and of length L, is as strong as a long pillar with both ends firmly fixed or well bedded and of length 2 L.

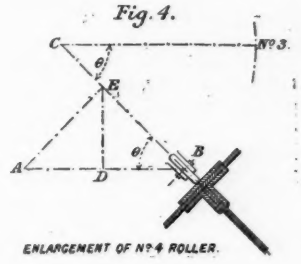
Stoney, p. 413, adds a table for calculating the strength of solid or hollow columns of cast iron, in which by comparing the figures given for columns both ends flat and

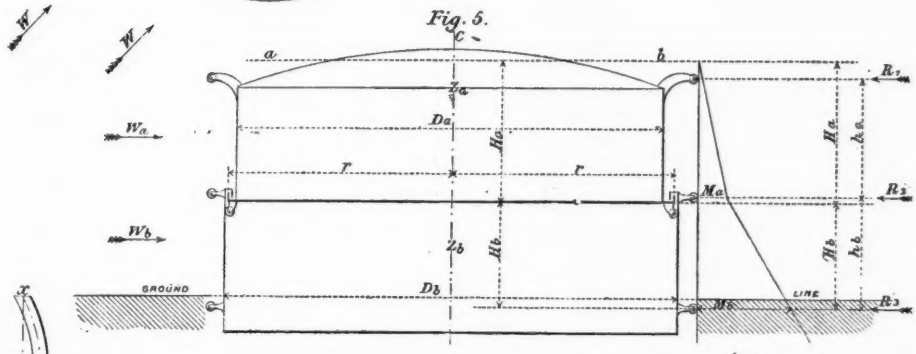
* The values of E, the modulus of elasticity, will be found in "Molesworth," p. 23, and its definition given in "Stoney," p. 7, as "the weight in pounds requisite to extend or shorten a bar whose transverse section is one square inch by an amount equal to its length upon the imaginary hypothesis that the law of elasticity holds good for so great a range."

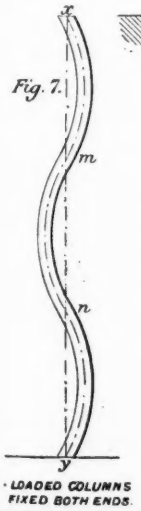


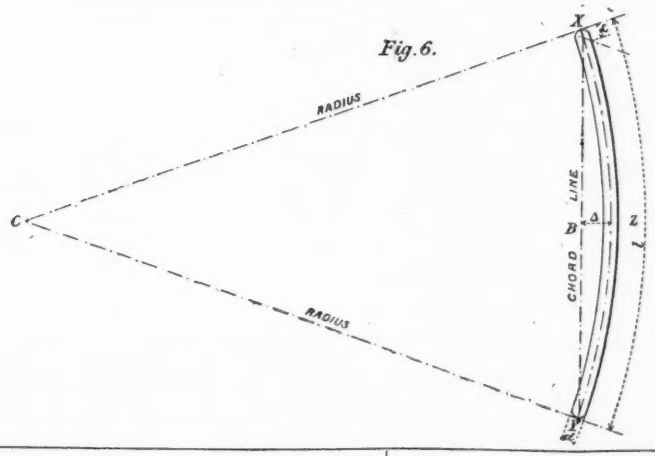


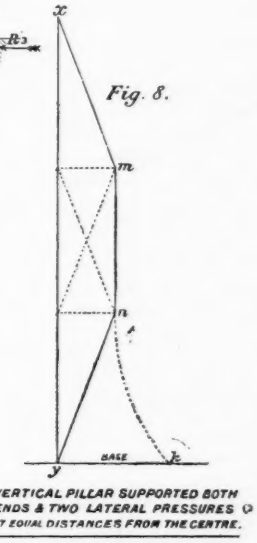












bedded with extreme care, using the figures given for half the ratios of columns with both ends jointed or imperfectly fixed, the amounts are seen to be identical.*

For a ratio of 10, the breaking limit stress per square inch of a round column one end imperfectly fixed, the other end bedded flat (or one end hinged, the other rigidly attached), will be $\frac{1}{2}$ (28·8 + 18) = 23·4 tons per square inch; so that, by allowing a factor of safety of 9, the safe stress per square inch = 2·6 tons. In the table in Stoney, p. 413, above alluded to, P = 36 tons and $b = \frac{1}{400}$.

*Thus for a length of 10 diameters the breaking limit stress equals 28·8 tons per square inch for a round column with both ends flat and firmly bedded; but if both ends are jointed or imperfectly fixed, the breaking limit stress of 28·8 tons per square inch is only applicable to a length of 5 diameters, the breaking limit stress in the latter case for ten diameters amounting to only 18 tons per square inch (see Table in Stoney).

$$f = \frac{36}{1 + \frac{r^2}{400}} \text{ (fixed ends) } f = \frac{36}{1 + \frac{r^2}{100}} \text{ (free ends).}$$

At the first glance the unit stress of 2·6 tons per square inch appears small; but it must be borne in mind that, with horizontal pressures, there is a tendency to throw one side of the cast-iron columns into tension, and that even with vertical loads there is a difficulty with a fixed end to ensure the load passing in a true vertical direction down the central line or axis of the column.

Stoney (Art. 372, p. 405) mentions two experiments on long solid cast-iron pillars with the ends formed so that the pressure would not pass through the axis, but in lines one-fourth of the diameter, and one-eighth of the diameter respectively, from one side, in which the breaking weights were little more than one-half that of a pillar of the same

Rolled Steel Stanchions, Cruciform (+) Section.

A.—6 inch.

Length in feet.	Weight per foot run.	Breaking Weight, Ends fixed.	Safe Load, Ends fixed, Factor 4.	Breaking Weight, Ends free.	Safe Load, Ends free, Factor 4.
	lbs.	Tons.	Tons.	Tons.	Tons.
8	32·25	191·406	47·8515	143·718	35·9295
10	,,	178·626	44·6565	122·844	30·7110
12	,,	165·756	41·4390	104·496	26·1240
14	,,	154·908	38·7270	89·418	22·3545
16	,,	143·718	35·9295	75·882	18·9705
18	,,	132·960	33·2400	65·076	16·2690
20	,,	122·844	30·7110	56·178	14·0445
22	,,	113·310	28·3275	48·762	12·1905
24	,,	104·496	26·1240	42·630	10·6575
26	,,	96·336	24·0840	37·488	9·3720
28	,,	89·418	22·3545	33·138	8·2845
30	,,	82·140	20·5350	29·478	7·3695

B.—8 inch.

8	57·8	377·992	94·4980	305·372	76·3430
10	,,	358·310	89·5775	275·382	68·8455
12	,,	348·182	85·0455	245·300	61·3250
14	,,	323·300	80·8250	217·848	54·4620
16	,,	305·372	76·3430	192·942	48·2355
18	,,	291·056	72·7640	170·920	42·7300
20	,,	275·382	68·8455	151·660	37·9150
22	,,	260·180	65·0450	134·818	33·7045
24	,,	245·300	61·3250	120·222	30·0555
26	,,	231·280	57·8200	107·578	26·8945
28	,,	217·848	54·4620	96·570	24·1425
30	,,	204·810	51·2025	86·588	21·6470

C.—10 inch.

8	88·1	595·6016	148·9004	496·619	124·154
10	,,	565·4650	141·3662	456·887	114·221
12	,,	540·1210	135·0302	418·755	104·688
14	,,	517·5328	129·3832	382·247	95·561
16	,,	496·6194	124·1548	346·532	86·633
18	,,	476·5874	119·1468	315·730	78·932
20	,,	456·8870	114·2217	286·988	71·747
22	,,	437·7178	109·4294	259·987	64·997
24	,,	418·7550	104·6887	236·151	59·037
26	,,	400·3792	100·0948	214·749	53·687
28	,,	382·2470	95·5617	195·419	48·854
30	,,	364·8016	91·2004	178·442	44·610

F.—8 inch.

10	57·8	349·0858	87·2714	264·2220	66·0555
15	,,	303·9264	75·9816	195·8708	48·9677
20	,,	264·2220	66·0555	144·6224	36·1556
25	,,	228·0684	57·0171	108·3446	27·0861
30	,,	195·8708	48·9677	82·8822	20·7205
35	,,	168·2252	42·0563	64·8838	16·2209
40	,,	144·6224	36·1556	51·9772	12·9943

E.—10 inch.

10	88·1	556·4790	139·1197	441·5802	110·3950
15	,,	493·1076	123·2769	350·6670	87·6667
20	,,	441·6696	110·4174	275·1048	68·7762
25	,,	394·6068	98·6517	215·8578	53·9644
30	,,	350·6670	87·6667	171·0666	42·7666
35	,,	310·9284	77·7321	137·4360	34·3590
40	,,	275·1048	68·7762	111·9330	27·9832

D.—12 inch.

10	122·37	798·3870	199·5967	645·8112	161·4528
15	,,	710·4284	177·6071	535·4952	133·8738
20	,,	645·6812	161·4203	439·1418	109·7854
25	,,	588·7300	147·1825	358·3200	89·5800
30	,,	535·4952	133·8738	292·7718	73·1929
35	,,	485·4846	121·3711	240·8846	60·2211
40	,,	439·1418	109·7854	200·1606	50·0401

Note.—The letters A. B. C. D. E. F. refer to the "Diagram of Sections."

dimensions with the ends turned or planed, so that the force would pass through the axis—that is, their strength was reduced to about one-fifth that of a similar flat bedded pillar.

The following comparison of statements by Molesworth and Stoney, for the breaking-weight of a rectangular section, may assist the discussion of this paper.

Cast Iron.

P = 35 (Molesworth) P = 36 (Stoney)
Ends fixed, b = ·0037 (Molesworth) $b = \frac{1}{500}$ or ·002 (Stoney)
Ends free, b = ·0148 (Molesworth) $b = \frac{1}{125}$ or ·008 (Stoney)

Wrought Iron.

P = 16 (Molesworth) P = 16 (Stoney)
Ends fixed, b = ·0005 (Molesworth) $b = \frac{1}{3000}$ or ·00033 (Stoney)
Ends free, b = ·002 (Molesworth) $b = \frac{1}{750}$ or ·00132 (Stoney)

For pillars of angle, tee, channel, and cruciform iron, the units to be applied are: P = 19 tons, and $b = \frac{1}{900}$ or ·0011 with ends fixed (Stoney, Art. 384, p. 419). In each of such sections, lettered H to N in the "Diagram of Strains," the least diameter for calculation should be measured in the direction marked x, in which the pillar is most flexible, as shown in the diagram. Reducing the strut to a flat plate at the ends for the purpose of connection, reduces

the strength by from one-tenth to one-third according to some authorities.

Steel.

To calculate rolled steel stanchions, we will assume a unit strength for mild steel = 30 tons per square inch, and apply Gordon's formula for columns and pillars in the first place fixed at the ends. $f = \frac{P}{1 + b r^2}$ where f = crippling strain in tons per square inch.

P = ultimate crushing strain of a short length of material in tons per square inch = in this case, 30

b = coefficient depending upon material and shape of cross section.

L = length of column in the same units as d.

d = diameter of column in direction of greatest flexure

$r = \frac{L}{d}$ = the ratio of length to diameter.

b (Baker—"Beams, Columns, and Arches") for mild steel circular columns fixed at the ends = $\frac{1}{14000}$

b is derived in the following manner, the coefficient b for round iron = $\frac{1}{20000}$, and as steel is about $1\frac{3}{4}$ times the strength of iron and $1\frac{1}{4}$ times as stiff, b for steel would = $\frac{1 \times 1\frac{3}{4}}{2000 \times 1\frac{1}{4}} = \frac{1}{1430}$, which Sir Benjamin Baker states as $\frac{1}{1400}$.

b (Baker) for mild steel rectangular columns not fixed at the ends = $\frac{1}{6250}$. This divided by $4 = \frac{1}{24800}$ = b for rectangular columns fixed at the ends. Pillars with both ends jointed or imperfectly fixed, $f = \frac{P}{1 + 4 b r^2}$. Pillars with both ends flat and bedded with extreme care, $f = \frac{P}{1 + b r^2}$. If the coefficient, a constant depending upon the material and shape of the cross section, when the "ends are fixed" = b then the coefficient for "ends round" = $4\ b$

$$4\ b = \frac{1}{6250} \qquad b = \frac{1}{24800}$$

see Art. 390—"Solid steel pillars;" Stoney, p. 439 (1886 edition).

The risk of hidden flaws or of side blows to a vertical column, coupled with the lateral administration of strain to a gas standard, is very much in favour of an open or cruciform section; and with cruciform stanchions it appears fair to assume that buckling will take place in the direction of one of the webs. Sections A, B, C, D, E, F, G show forms capable of passing through rolls in the course of manufacture; and their strengths are stated for various relative heights in the preceding table.

The comparative strength of sections in long solid columns in which the sectional area and length are the same in each case, is stated by Molesworth, p. 112, to be as follows:—

Cylindrical	100
Triangular	110
Square	93

It is, however, to be observed that the shape of a triangle will generally prohibit its adoption in construction.

Stoney, p. 412, asserts the following:—

Section G	= 100
Section N	= 75
Section P	= 44

Comparing the equations already given for solid rectangular and solid round pillars, we find the relative values of F to be $\frac{2 E b d^3}{3 l^2}$, and $\frac{\pi E d^4}{8 l^2}$; or as $\frac{2 \times 8}{3 \times \pi} = 1{\cdot}7$.

Hodgkinson's experiments make a long solid square cast-iron pillar 1·5 times the strength of that of a solid inscribed circle. Now 1·7 is as close an approximation to 1·5 as we can expect from a theoretical investigation, when we bear in mind that Hodgkinson's experiments were to a great degree made upon pillars whose lengths were not much over 30 diameters. Again Stoney (Art. 381, p. 414) states that it appears "from Hodgkinson's experiments that the unit strength of a long, solid, square cast-iron pillar is 1·178 times that of the inscribed circular pillar of equal length;"* whereas its area (*i.e.*, its weight) is only 27 per cent. greater. Hence, we argue that the area of a square being 1·27 times that of the inscribed circle, while the total strength of a solid square pillar is 1·5 times that of the inscribed circle, and as the strengths of any two solid square pillars of equal lengths are as the squares of their areas $\left\{F = \frac{2 E b d^3}{3 l^2} \text{(see p. 21)}\right\}$ $F = \left(\frac{2 E}{3 l^2}\right) d^4$, if we suppose a smaller square whose area equals that of the inscribed circle in the larger square, then the total strengths of these two squares (the larger and the smaller ones) are as the squares of their areas—that is as $\left(\frac{127}{100}\right)^2 = 1{\cdot}6129$.

So that the strength of the larger square = 1·6129 times that of the smaller one; while being *square*, it is also equal to 1·5 times the strength of a round inscribed pillar. Consequently the strength of the smaller square pillar is to that of a round pillar of equal sections and of equal weights, as $\frac{1{\cdot}5}{1{\cdot}6129} = {\cdot}93$, or 93 per cent. in ratio.

Again, the strength of a solid square pillar whose length equals that of a solid inscribed circle (calling the strength of the latter 100) = $\frac{150}{(1{\cdot}27)^2} = \frac{150}{1{\cdot}6129} = 93$, as stated above.

The author concluded his paper with some brief references to the varying constructions noticeable in gasholders erected at Glasgow, Newcastle and Gateshead, the East Greenwich works of the South Metropolitan Gas Company, Lower Sydenham, Manchester, the Kennington Lane station of the South Metropolitan Gas Company, Stockton, Lincoln, York, Cape Town, and Runcorn—the different types of standards or columns employed being illustrated by a series of drawings shown at the meeting.

The Gaslight and Coke Company's Assessment Appeals.—The Gaslight and Coke Company recently appealed to the Chelmsford Quarter Sessions against their assessment in the parish of West Ham, where they were rated for their Bromley works at £40,000 rateable value. The Court allowed the appeal on the technical grounds that the description in the rate-books was incorrect. The Company have, however, now agreed with the valuer for the parish (Mr. W. P. Ryan, C.E., F.S.I., of Messrs. Morris and Ryan, Ingram Court, Fenchurch Street), to an assessment of £39,300, which is £5125 more than the amount to which they claimed to be reduced—viz., £34,175.

Society of Arts.—The Council of this Society have just elected Sir R. E. Webster, Q.C. (the Attorney-General), Chairman, and Sir F. Bramwell, Bart., F.R.S., Deputy-Chairman, for the ensuing year. In their report on the work of the past session, the Council remark that electricity did not take so prominent a place among the subjects dealt with at the ordinary meetings as in recent years. There were, however, two papers—viz., one on "Secondary Batteries," by Mr. G. H. Robertson, giving the results of much valuable and original work; and the other by Mr. J. N. Shoolbred, describing the arrangements made by the Bradford Corporation for the supply of electricity to that town. Referring to the paper on the "Spontaneous Ignition of Coal," read by Professor Vivian B. Lewes, F.I.C., F.C.S., for which he was awarded a silver medal, the Council remark that in it he offered numerous practical suggestions with reference to the carriage of coal by sea. Mention is also made of the paper on "Burning Oils for Lighthouses and Lightships," by Mr. Price-Edwards, which was noticed in the JOURNAL a few months ago. Among the Cantor Lectures of the past session, were a series by Professor W. Robinson, on "Petroleum-Engines," and another on "Recent Bacteriological and Chemical Research in connection with the Fermentation Industries," by Dr. Percy Frankland. In the former, the uses of the class of engines specially dealt with were pointed out; and in the latter the author gave a very lucid exposition of the recent advances which have been made in the study of micro-organisms. Among the losses the Society sustained by death last year were Dr. A. Carpenter and Dr. C. Meymott Tidy; and, being a Gold Medallist, Dr. A. W. Hofmann's name is included in the obituary notices. The Society's annual *conversazione* took place last Wednesday, at the South Kensington Museum, by permission of the Lords of the Committee of Council on Education.

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* The result 1·178 is thus arrived at: Area of a square : Area of inscribed circle as $x^2 : x^2$ (·7854). Now it has been stated (Art. 378, p. 412) from experiments of Hodgkinson, that the total strength of a solid square cast-iron pillar is about 50 per cent. stronger than a solid round pillar of the same length and of diameter equal to the side of the square. Therefore the unit-strength of a long, solid, square pillar = 1·5 × ·7854 = 1·178 times that of the inscribed circle.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 40.)

BUSINESS on the Stock Exchange remained quite as quiet last week as it had been for some time past. The settlement was light, and was attended with only one mishap, of minor importance. The tone on the whole was flat, and prices drooped; but towards the end of the week, there was some slight disposition to improve. Whether the General Election is fairly the chief cause of this stagnation, will be better known when it is over; but if the result should be unfavourable to the present Government, there will probably be sharp movements in some securities—*e.g.*, Egyptian. There is nothing much to note in the Money Market. As usual at the close of the half year, a temporary demand sprang up; but as soon as this was satisfied, the market relapsed into its old condition. The Gas Market has been quiet, though there was rather more activity after the settlement. The tone has been uniformly good, and prices have advanced. The protest of the London Clubs against the heavy charges of the Electric Lighting Companies may open people's minds to the fact that, notwithstanding the recent rise in the price of gas, it is still incomparably cheaper than electricity, and there will always be a brisk demand for a cheap commodity. In Gaslights, the "A" has been done steadily throughout the week at about the same figures (the closing price, 210, being the same as that of the preceding week), with an improvement of 1 in the quotation. The secured issues were hardly touched; but the "J" 10 per cent. preference is quoted 2½ better. Some moderate business was transacted in South Metropolitan, which showed a slight tendency to improve; but the quotations were left unchanged. Nothing was done in Commercials except in the debenture stock, which advanced 1. A single transaction in British represented the extent of the interest taken in the Suburban and Provincial undertakings. Among the Continental group, Imperial was brisk, and effected a good recovery from its recent recession; the quotation showing an advance of 4. Of the rest, Bombay was flatter, and fell ¼; but Buenos Ayres debentures, upon which the half-year's interest has just now been paid, were 1 higher. Australian was also fractionally better upon *ex div.* adjustment. Water stocks were very quiet, but generally disposed to firmness; and *ex div.* changes are mostly for the better.

The daily operations were: Gas opened well on Monday, and prices were good all round. Gaslight "A" and Imperial Continental improved 1 each. Business was quieter on Tuesday; but prices did not slip back. Wednesday was very inanimate; and everything remained unchanged except Bombay, which fell ¼. On Thursday, activity was revived; and prices moved up. Imperial Continental rose 3; and Commercial debenture, 1. Changes in Water were effected as noted in the list. The tendency continued favourable on Friday; and Australian and Buenos Ayres debentures advanced 1 each. Quietude and firmness characterized Saturday; and the only alteration was an advance of 2½ in Gaslight "J" 10 per cent. preference.

ELECTRIC LIGHTING MEMORANDA.

The London Clubs and the Cost of Electric Lighting—The Mystery of a Gas-Meter and an Electric Light Wire—Close of the Crystal Palace Exhibition.

LAST week the Secretaries of the principal clubs of the West-end of London which have adopted electric lighting held a meeting for the purpose of expressing dissatisfaction with the charges of the supply companies. The incident is rather ominous for the companies; for it is notorious that these cannot make much money out of the lighting business, high as are their rates, and they have no prospect of attracting any fresh custom until the comparison of the cost of electric lighting with that of gas can be made to look very different from its present aspect. "Clubland," as the area occupied by the St. James's and Pall Mall Company is commonly called by the newspapers, ought to be a happy hunting-ground for the electricians; but the protest of the Club Secretaries serves to remind them that there are limits to expenditure even for the luxuries of club life, among which incandescent electric lighting is now conventionally included. The clubs have found out what so many private patrons of electrical supply companies have also discovered—that there is a lamentable discrepancy between the estimated and actual cost of incandescent lighting. The excuse made for this by electricians is that users of incandescent lamps insist upon having an increased amount of light as compared with gas; and accordingly they multiply the number and power of their lamps in a degree which is not realized until the bill comes in. But the truth is the other way. Patrons of electrical supply companies allow themselves to be persuaded at first that an 8-candle incandescent lamp is as good as a gas-burner. General Webber, of the Chelsea Company, has said as much, over and over again; nor is he alone in this case. When the lamps are installed, however, and the nominal 8 candles have dropped to 6 or even to 5 candles actual, as they will do in the course of a week or two, people begin to grumble at not being able to see about the rooms, to read or write, to eat their dinner, or to do anything else that requires the use of their eyes. So the 8-candles are exchanged for 16-candle lamps, and these again for 32-candle lamps—which are none too bright for ordinary purposes. It is unnecessary for us to point out how this adds to expense. Alarmed for their future, the electricians are trying to mend matters in various ways. The Westminster Company have taken 1d. off the price of the unit, which is now 7d. instead of 8d. in their important district. An apologist has also hastened to put in once more the hackneyed plea that, even if electricity does cost more than gas, it saves money in decorations, &c. Admitting that this pretence holds good, there must still be a point at which the balance of advantage may be struck. It is evident that when a club which paid £100 a year for gas is required to pay £400 a year for electricity, the difference would go a great way for whitewashing ceilings or cleaning paint. And when the usual annual cleaning must be gone through for sanitary reasons, irrespective of the question of the system of lighting in use, the plea fails entirely.

We have been asked by the Secretary of the St. James's and Pall Mall Company to give prominence to the ultimate findings arrived at with regard to the remarkable gas explosion in Piccadilly, when a meter belonging to The Gaslight and Coke Company was destroyed, as it was at one time supposed, through some action set up by the electric light wires. We gladly do this, and congratulate the St. James's Company upon their deliverance from a burden of suspicion which would undoubtedly have been deterimental to their prospects. The incident must be henceforward remembered as one of those mysterious occurrences nobody can understand. We shall not accuse electric lighting currents of entertaining such animosity to gas as to constrain them to commit assault and arson whenever they find themselves in the same room with the gas-meter. Electricity is far too advanced and scientific a thing to indulge in conduct so unworthy of one of the "glorious gains" of the nineteenth century. At the same time, we cannot believe that gas would be so unprincipled as to fire back from a heating-stove to a meter in the next room, merely to gratify an envious desire to get the harmless electric lighting wires into disgrace. Let us put the incident aside, and think no more about it. In these "Memoranda" of ours we are, above all things, solicitous to be fair to the objects of our criticism; and it is a matter upon which we pride ourselves that, for all the hard and unpleasant things we have had to say on electricity and electricians these many years, no man has had to call us to account for a wilful misrepresentation, or has convicted us of unwillingness to do justice to an opponent.

The Crystal Palace Electrical Exhibition is over; having closed last Saturday without, we may say, being overmuch regretted by frequenters of the Palace, who have found it sadly in the way of their customary promenades. Many of the stalls have been in a "sere and yellow" condition for a month or two past; while others have bravely kept up appearances to the end. It does not take much labour in analysis to arrive at a final opinion respecting the show and its effect upon the British electrical industry. Apart from the educational contribution of the Post Office, and the repetition of Mr. Tesla's experiments by Messrs. Siemens Bros. and Co., and Messrs. Swinburne and Co., there was no pretence to a scientific purpose by any exhibitor. It was a scheme of advertisement purely—very good, honest advertisement, in the main, but still advertisement. The object of the exhibition was wholly and solely commercial; and therefore by its commercial results it is to be judged. Upon this basis, what has been the fruit of the enormous outlay by the exhibitors? If these would only confess the truth publicly as freely as they do in private, it would be to the effect that they have very far from recouped themselves, and see no prospect of doing so either directly or indirectly. For the exhibitors, the enterprise has proved a ghastly failure; and we may be sure that there will be no repetition of such a venture, either at the Crystal Palace or anywhere else, for many years to come. Of course, it is not to be expected that an open confession to this effect will be made; because many of the exhibitors are joint-stock companies, and their Directors know better than to cry publicly over "spilt milk." Others of the victims, if gently pressed on the subject, will confidentially admit that while they have done "as well as could be expected," their neighbours and competitors have done next to nothing. We have no hesitation, therefore, in expressing the conviction that while not one of the exhibitors at Sydenham has anything to boast about, most of them have simply thrown money and trouble away. Finally, the Palace authorities will be only too glad to clear the place of dynamos, wires, and machinery; and if the receipts from visitors who have been specially attracted to the Palace by the show suffice to pay the extra expenses, and the additional premiums for insurance, it will be something for which the Directors of the Palace may be thankful.

The Brussels Electric Lighting Scheme.—The tender of the India-Rubber, Gutta-Percha, and Telegraph Works Company, of Silvertown, which, as stated in the JOURNAL a few weeks ago, had been provisionally accepted for carrying out an installation of electric lighting in Brussels, has been definitely sanctioned by the Municipal Council.

GAS ADMINISTRATION SYSTEMS.

It is rather a strange thing that, amid all the variety of topics which have been handled by writers of papers for our principal Associations of Gas Managers, one highly important subject—one of the most important, indeed, of all those which ordinarily engage gas managers' attention—has never been included. We refer to the comparative study of the administrative devices under which gas supply is carried on in this and other countries, to the end that the public and private interests involved shall be protected and harmonized. Papers have been written upon sections of this subject—such as the sliding scale of British statutory regulations; but nothing like a comprehensive review of the diverse plans of administration that actually govern the gas industry in all parts of the world, has been attempted. It is not our intention to enter upon any such labour; but we may perform a useful task in drawing attention to the nature and extent of the material that awaits critical treatment at the hands of any public-spirited engineer who may devote his leisure, between now and next summer, to the instructive work of collecting, digesting, and reporting upon the world's methods of administering gas supply, with a view to exhibiting the best system. Such a labour, it may be premised, would turn out to be more tedious and painful than difficult. A mass of published information would have to be gone through and corrected by the result of independent inquiry and observation. But the fruit of all this labour, if intelligently directed, could hardly fail to possess extreme value; and the investigator who had gleaned it would occupy a lofty standing as an authority upon questions of gas polity.

To begin with, there is the actual gas supply of the United Kingdom to be inquired into. History would have to be ransacked to establish the record of how the British gas industry was founded, how it survived the era of commercial competition, how it fell into the lethargy which resulted in the consumers' agitations of the middle of the century, how the movement for the acquisition of gas undertakings by local authorities was originated and maintained, and what are the true effects of the different principles that actually govern gas supply throughout the United Kingdom. The world has not stood still in respect of gas-works' regulation since the sliding scale proclaimed, in clearer terms than had ever been heard before, the rule that in this business, suppliers and supplied are in partnership with one another for their mutual advantage. The legalization of the sliding scale of price of gas and rate of dividend for British Gas Companies was, of course, a great step in advance; but it was only the plainer enactment of a principle that had been of necessity recognized from the time when experience had proved the unsuitability of simple commercial competition for the function of adjusting the relations between buyers and sellers of gas. It was for some years doubtful how far the inner meaning of sliding-scale gas legislation bore upon the administration of gas undertakings by local authorities. The celebrated Oldham case showed, however, that, notwithstanding the silence of local statutes on the point, it is no longer competent for a corporation owning a gas undertaking to treat the public as though it had no rights which the suppliers of gas are bound to respect.

Contrasted with the English custom in the matter of the municipal supply of gas, which can be, and frequently is so ordered as to tax the minority of the community for the benefit of the majority, stands the more equitable Scotch custom, under which gas supply must be carried on by a municipal authority as a public trust and not as a source of profit. Our imaginary investigator would naturally inquire how such a striking difference of principle and practice arose; and he would trace its effects upon gas undertakings and communities. Again, the various experiments that have been instituted in English towns with the object of automatically regulating the price of gas (such as that of Ramsgate), would all be passed in review, not merely as precedents in legislation, but also with regard to their practical issues; so that light would be thrown upon the matter for the guidance of future experimenters in the same branch of constructive legislation.

Then these home affairs should be compared with what goes on abroad. The European concession system has never been impartially studied, nor its tortuous ramifications followed up. This would, indeed, be the most difficult and hopeless part of the task we have sketched out; for there was a large amount of secret dealing in connection with the origin of this particular system of gas supply, the bearings of which will never be made manifest. There is little mystery now, however, about the conditions of Continental gas supply. Such right and fairness as can be ascribed to the concession system has been so assiduously brought to light and practised by the honourable order of English exploiters of the gas business on the Continent, of whom Mr. H. M'Lauchlan Backler is the recognized representative, that the present working of gas undertakings under this system leaves little of which the consumers or local authorities can complain. At any rate, such grievances as the former have to endure are seldom fairly ascribable to the gas company who work the concession, but more often proceed from the anxiety of their own national and communal governments to utilize the gas company as an agent for taxation.

The great field for experimental gas administration is, however, the United States. Here everything seems to be tried over again, without the slightest reference to experience gathered elsewhere. We hear a good deal from chemical circles just now of the re-determination of atomic weights and other constants, which painstaking students are continually doing for their own satisfaction and the solace of the world at large, which would naturally be terribly upset if it were reported that any element had been wrongly listed by the early experimenters. It would seem that in the United States all sorts of re-determinations of industrial and other constants are always in progress—nay, it might be said that, in regard to a good deal of what goes on in the States, action is taken totally irrespective of the existence of any constants. No small portion of the youthful energy of the States is consequently being expended in the discovery and verification of old truisms. This is conspicuously true in respect of the gas industry. Every fallacy of gas administration which has been exploded, at vast expense, upon this side of the Atlantic, reappears again and again upon the other; and the diversity of the State laws so effectually masks the universality of economic principles, that the same experiments may be seen in progress in various stages in many different localities at once, not one being able to learn from the other. By the time the United States become so homogeneous as to feel the effect of an economic error at any great distance from the place of its perpetration, the youthful capacity of recuperation which distinguishes the country may be spent; and then American gas supply will have to sacrifice its wild variation of administration, and with this will go much of its peculiar interest.

We began by suggesting that a paper should be written upon the general subject; but it might be gathered, from what we have already had to advance in support of this view, that a volume would hardly accommodate all the facts that could be collected for the elucidation of the conditions of the gas supply of any country. Certainly, anything worthy of being called a complete presentment of the various arrangements under which American gas companies work would fill a good many printed pages; but a skilfully prepared abstract might be sufficient for all practical purposes. We do not want to know the circumstances of every gas company everywhere, but only how typical systems of administration work. For the thing to be borne in mind is that all varieties of gas-works administration have ostensibly the same reason for existing—the supply of good gas to the community on the best terms for producers and consumers; not forgetting the general public, who may conceivably be neither. How is this end to be attained; and where is it most nearly achieved? These are the questions requiring to be answered.

It would not be surprising if the work of inquiry into this matter were to be first taken up on the other side of the Atlantic. There is a new school of publicists springing into prominence in connection with more than one Transatlantic University, which aims at bringing about a closer connection between the gains of collegiate training and the transactions of common every-day life. It has been felt, with good reason, as a reproach to the American educational system, that colleges wherein the most advanced science is taught, should co-exist with democratically governed towns, exhibiting the deplorable results of the administration of public business according to the notions of the most ignorant, heedless, and corrupt members of the body politic. How was this scandal to be removed? Not by sending the voters and politicians to school again; for they would not go, and if they went they could not understand the teachers. Consequently, the only alternative was embraced, in many places, with a fervour beyond all praise, provided that it lasts. The teachers left the schools and went into the towns, where they held forth, for the instruction of all who chose to listen to them, upon the elementary data of political, social, and industrial economy. Moreover, their lectures were published in the newspapers, and issued afterwards as pamphlets for the benefit of readers who could not attend the meetings at which they were delivered. Precisely how much effect this sort of teaching may have, cannot be predicted; but it is at least possible to contend that no harm can come of reasoned attempts to convince townspeople as to the folly of relying upon competition, as they understand it in ordinary business, to cheapen a gas supply, or of any similar essays in the stubborn field of the education of the adult citizens of a self-governing community.

It is because attempts of this kind have already been initiated in America that the systematic study of the conditions of gas supply may conceivably be taken up there, not by gas managers in active service, who have other work to do, but by what we may term University Extension teachers. These gentlemen would be quite justified in attending to the matter upon the twofold ground that a good and cheap gas supply is one of the greatest boons any community can receive at the hands of its governors, and that the arrangements of gas supply in the United States are, on the whole, almost as bad as anything of the kind can be. But we are not content to regard this subject as something which American college tutors can take in hand if they choose to do so. It ought to be treated from the British standpoint also, in order that any demonstrable defects in our national methods of gas administration may be removed, and the practical skill and the public spirit of

British gas engineers may be delivered from any legislative or customary impediments existing in the way of the discharge of their duty, which is to sell the best and cheapest gas and to disseminate the benefits of such supply among the greatest number of those for whom it can be made available. And those who know how much depends upon this apparently narrow issue will pardon us for insisting upon its importance. The cheapness, goodness, and popularity of gas means very much more than the mere selling of so much of a merchantable commodity, the employment of a number of men, and the working out of a particular technical problem. It means all these, and more—how much more, it is unnecessary to indicate here.

NOTES.

An Improved Siemens Pyrometer.

Some years ago, and for a considerable period, the only pyrometer recognized as possessing any practical value for experimental determinations of the heat of gas-retorts, &c., was the Siemens instrument, which was based upon the property of platinum of altering its electrical resistance with a rise in temperature. Unfortunately, it had been found that the Siemens platinum pyrometer was subject to the serious drawback that its zero changed with use, owing to the rapid deterioration of the wire under repeated heatings. Mr. Callendar has found, however, that this is principally a defect of structure of the instrument, and is not due to any inherent quality of the platinum wire. He recently told the Iron and Steel Institute that if the wire is properly protected from strain and from contamination, platinum resistance pyrometers can be made practically free from change of zero even at high temperatures. Instead of the clay cylinder and iron tube of the original form of Siemens pyrometer, Mr. Callendar winds his wire upon mica, and encloses it in refractory glass, hard porcelain, or silica. Hard-glazed porcelain does very well to protect the wire up to a temperature of 1200° C. A pure silica tube would be better, and this Mr. Callendar has hopes of being able to produce; but he has not satisfied himself upon this point. What with the improved Siemens instrument and the Le Chatelier arrangement, pyrometry bids fair to take a more assured position as an aid to furnace working than it has hitherto occupied.

The Combustion of Nitrogen in Air.

At the recent *conversazione* of the Royal Society, Professor W. Crookes offered a novel explanation of the phenomena of the so-called "long arc" which visitors to the Crystal Palace Electrical Exhibition will remember as shown in the course of the high-tension experiments of Messrs. Siemens Bros. and Co. and Messrs. Swinburne and Co. In these displays, which were made fashionable by Mr. Tesla, the arc breaking out between a pair of electrodes carrying high-tension currents, of from 50,000 to 100,000 volts, takes the appearance of a pair of lambent flames issuing from both electrodes, which seem to burn languidly in the air so long as they touch one another at any point. When contact is interrupted, the flames go out; but they can be started again either by approaching the electrodes to one another or by introducing the flame of a taper between them. These flames resemble the effect of combustion; but the electrodes do not burn. Professor Crookes now asserts that with this phenomenon there is an actual combination of the oxygen and nitrogen of the atmosphere, with nitrous and nitric acids as the products. In other words, that the phenomena is that of burning atmospheric nitrogen, the possibility of which was discussed in Professor Vivian B. Lewes's book upon "Air and Water" recently reviewed in the pages of the JOURNAL. The idea of the ignition of atmospheric nitrogen, supposing Professor Crookes's explanation to hold good, is somewhat alarming, since it then becomes a question why all the nitrogen of the air does not ignite at once, and bring the earth to sudden destruction under a deluge of nitric acid. The only reason why this result has not happened before, and cannot happen now, is that the temperature produced by burning nitrogen is not sufficiently high to keep up the process. Its igniting temperature, in short, is far above its combustion heat. Probably this is so with many other so-called incombustible bodies.

Air Pollution in Manchester and Salford.

The Town Gardening Committee of the Manchester Field Naturalists Society are persevering with their observations upon the condition of the atmosphere of Manchester and Salford. By means of a staff of observers in different parts of the city and suburbs, a mass of information has already been collected regarding the nature and distribution of fog. The points to which attention has been particularly directed are the duration of fog; its localization or general distribution; and its variability of character, odour, colour, &c., in different localities. Last winter was not particularly foggy in Manchester, in consequence of the unsteadiness of the barometer. Fogs nevertheless occurred upon many dates; but they were mostly partial, either lasting only a short time, or being very local, or both. It is remarked that the whole of the October fogs were shallow, hardly extending above the houses; so that blue sky could be seen directly overhead, even through the fog. Summarizing a mass of collected details, the following conclusions were drawn by the Committee with regard to the fogs of the past winter: That fogs almost invariably follow a steady, or a steadily rising barometer. When partial, they are most likely to occur in the neighbourhood of streams. Certain centres in Manchester seem to be specially liable to thick fogs. Fogs in London, so far as the more central parts of the city are concerned, are more noxious, and contain more sulphurous acid, than the corresponding Manchester fogs, although the difference is not very considerable. Taking the example of a typical dense black fog in London, it is recorded that the atmosphere at St. Bartholomew's Hospital showed 49·50 milligrams of sulphurous acid per 100 cubic feet. In clear bright weather, the amount of sulphurous acid present in the air of towns is in summer 0·2 to 0·5, and in winter 1·7 to 3·0 milligrammes per 100 cubic feet. When the proportion of sulphurous acid attains 5 milligrammes, its odour can usually be detected. A sample of hoar frost collected in the Oxford Road, Manchester, from aucuba leaves, yielded 89 parts per million of sulphurous acid. If this rime were allowed to remain, it would kill the leaves. Comparative measurements of the intensity of daylight at the same hour in different localities were also made, with the result that if the intensity of daylight at noon on December 27 (the air being clear), is expressed by the figure 20 for the Grindelwald, it would be 11 for Torquay; 7·5 for the Malvern Hills; for Kew, Hampstead, or Didsbury, 3 to 4; Oxford Road, Manchester, 1·2; Manchester and Salford (central), 0·8. Thus the amount of light received in three minutes' sunshine in the Grindlewald was equivalent to that of three days at the same season in Manchester and Salford.

TECHNICAL RECORD.

SOCIÉTÉ TECHNIQUE DU GAZ EN FRANCE.

Annual Congress at Tarbes.

The Nineteenth Annual Congress of the above Society was held at Tarbes from the 7th to the 12th ult., under the presidency of M. MELON. The following particulars in regard to the meeting are translated from the current number of the *Journal des Usines à Gaz*, the official organ of the Society.

The congress opened on the morning of the 7th ult. with a muster of 50 members. This was a considerable falling off as compared with last year, when the meeting commenced with 224 members present. This, however, was in Paris; whereas the gathering now under notice was in the Upper Pyrenees. The report of the proceedings on the previous occasion having been read and adopted, the names of the new members and associates proposed for election were submitted and approved. Of the former, there were 15; and of the latter, 5. The President of the Incorporated Gas Institute being already, by virtue of his office, an honorary member of the Society, it was unnecessary for the Committee to specially nominate him. The report of the Committee on the general progress of the Society during the year was next presented by the President. It recorded the deaths of seven members, and the resignations of five others. The total is now 594—consisting of 20 honorary and 490 ordinary members, and 84 associates. The contributions made to the funds of the Society by various gas companies last year amounted to 22,325 francs (£893). Referring to these donations, the Committee pointed out that they were not the only means which enabled the organization to subsist, as an examination of its financial position would prove; but they helped them to recompense to a larger extent the authors of technical communications presented for their approval, and especially to increase very considerably, particularly of late years, the premiums awarded to meritorious workmen connected with the gas industry. When this practice was established in 1878, three prizes were given. Last year the number was 20; and this year it was to be 19, selected from a list of 45. Since 1878, there had been bestowed 162 premiums on workmen who have been considered by the Committee to deserve them. Reference was then made to the excellent relations existing between the Society and The Gas Institute. Of course, there was the usual exchange of invitations to the Presidents to attend the annual meetings; but the dates rendered this impracticable. Efforts are to be made to bring about a closer relationship between the members of the gas engineering profession in both nations by facilitating intercourse at the annual gatherings. Before closing their report, the Committee, in the name of the entire body of members, offered their congratulations to MM. Breittmayer, Cornuault, and Monnier, who, as already announced in the JOURNAL, have been made Chevaliers of the Legion of Honour; and the document concluded with an expression of thanks by the President for the kind and hearty support he had received during his tenure of office. The Treasurer (M. Deleury) then presented a report on the financial condition of the Society. It showed that at the close of the past year the capital had risen from 108,092 frs. (£4324) to 125,530 frs. (£5021)—being an increase of 17,438 frs. (£697). The next business was the selection of members of the Committee to replace those retiring. The ballot resulted in the re-election of MM. Brouardel, Deleury, Monnier, and Visinet for three years, and of M. de Vigne for two years.

This completed the general business at the morning sitting. The Committee afterwards held a meeting for the election of officers for the ensuing year. The following was the result: *President*, M. Paul Mallet; *Vice-President*, M. de Lachomette; *Secretaries*, MM. Visinet and Delahaye; *Treasurer*, M. Deleury.

On the resumption of the proceedings in the afternoon, the President delivered his Inaugural Address, a full abstract translation of which is given below. The remainder of the general business consisted in the presentation of the reports on the papers submitted in competition for this year's prizes, on the premiums awarded for papers read at the last meeting, and on the donations to meritorious workmen. A *mémoire* was sent in entitled "A Geometrical Study of the Processes Usual in Photometry," in which the author proposed to determine the extent of the errors which may be committed in making ordinary photometrical tests—dealing principally with those inherent to the methods employed. His work was based on the conception of a "sphere of equal illumination," as he designates the geometric positions of the points, the distances of which to the two sources of light to be compared bear a constant ratio equal to the square root of the ratio of the two-light sources. The Committee considered that the idea of a sphere of equal illumination was in evident contradiction of the fundamental law of photometry; and that, consequently, the conclusions which the author wished to draw were not correct, and therefore not open to discussion. Another *mémoire* bore the title of "Gas as a Motive Power." It was by M. Chauveau; and it completed the paper submitted to him at the meeting in 1890, for which he received a prize. His present effort, however, was not deemed by the Committee to possess sufficient merit to justify them in awarding him another. The third competition paper—one dealing with the legal positions of municipalities and lighting companies—gained for its author (M. Vanderpol) a premium of 1000 frs.; the Committee being of opinion that, in view of recent important decisions, the work was specially valuable to the gas industry. With regard to last year's communications, of which there were 16 in all (with an additional one sent in as a competing *mémoire*, and, with the author's consent, taken as an ordinary paper), some were the productions of members of the Committee, to whom according to the rules, no prize could be awarded. The Committee thought, however, that their works ought not to be passed over in silence; and therefore they placed them at the head of the list of those which they considered to be specially worthy of recognition. They were those by M. Coindet, M. Delahaye, and M. Mallet; the first being on the automatic regulation of the pressure of gas in street-mains, the second on the gas and electric lighting industries of Massachusetts, and the third on the distillation of ammoniacal liquor. Among the other communications, the Committee specially notice the papers by M. Guéguen, M. Chevalet, and M. Wehrlin, dealing respectively with the heating of gas-retort furnaces, the prevention of incrustation in steam-boilers, the scrubbing of gas, and the selection and care of gas-engines. Each of these gentlemen received 250 francs for his communication. As already mentioned, there were 45 applicants for the workmen's prizes of 200 frs. each, and 19 were awarded. The ages of the candidates ranged from 50 to 75 years; and their periods of service in connection with gas-works, from 23 to 56 years.

The papers presented at the meeting will be noticed in subsequent issues of the JOURNAL.

PRESIDENT'S ADDRESS.

M. Melon commenced his address by referring to the discourses of his two immediate predecessors in the presidential chair—M. Le Treust and M. Salanson. He reminded his audience that, at Lyons, in 1890, the former gentleman had, at the very outset, acknowledged his difficulty in saying "something that was not a mere repetition, and moreover a repetition very badly said." Since then, they had had M. Salanson's address in Paris, in which he presented, as in a vast picture, the general history of the progress of gas manufacture. He (M. Melon) had lately perused that brilliant discourse; and he at once perceived how heavy was the task that gentleman had imposed upon his successor, and how the difficulty alluded to by M. Le Treust had become almost an impossibility. In order not to expose himself to vain regrets, he thought it would have been well to dispense this year with the President's address; but he was reminded that he had no right to divest himself of his presidential authority. He would therefore review, as briefly as possible, the matters of interest which had characterized the past year.

The President then went on to say it appeared to him that gas engineers had lately been occupied with economical rather than with absolutely technical questions; and there were two which had already been the subject of important investigations in England. One was the use of oxygen in the purification of gas; and the other was the enrichment of gas by means of oil. Referring to the results obtained by Mr. Valon (whom he designated "the convinced apostle" of the oxygen process) with the aid of oxygen at Ramsgate, the President asked if this method of purification was susceptible of application in France, and if it would present economical advantages over the method actually in use. Mr. Valon's process had for its object to allow of the use of lime without exposing the user to the serious inconveniences which have caused this system to be abandoned almost everywhere. It had special advantages for those gas-works in which sulphurous coals were carbonized, which rendered purification by oxide of iron extremely difficult. In order to appreciate the economic value of the process, it would be necessary to be absolutely certain as to the net price of the oxygen. In Paris, 50c. per cubic metre had been mentioned. The continuous employment of 1 per cent. of oxygen would therefore entail an outlay of 50c. per 100 cubic metres (or 1·35d. per 1000 cubic feet) of gas made. Bearing in mind that the expenses of purifying are about 12c. per 100 cubic metres of gas, or 8c. for manipulation and 4c. for material, it appeared to him that the process was not susceptible of being advantageously employed except in particular cases. He considered it would be much more simple and economical to draw upon the oxygen contained in the air.

Passing on to deal with the subject of the enrichment of coal gas by other materials than cannel, the President cited the processes of Maxim and Clark, Dinsmore, Lowe, and Pintsch. With regard to the second, he said he did not believe it could be economically applied in France, seeing that it very materially reduced the commercial value of the resulting tars; while the adoption of the fourth depended upon the price of the raw material. The Maxim-Clark process, according to the figures presented by Mr. Frank Livesey, was very economical, as employed in England; and there was reason for supposing that in France, where the ratio between the prices of the oils and cannel would probably be still more advantageous, the economic results would be no less important. The Lowe process was next referred to; and the figures furnished by Mr. Goulden, at the recent meeting of the Incorporated Institution of Gas Engineers, were cited. Converting them into equivalent French values, the gain of a candle in illuminating power would cost about 0·4c. per cubic metre. Water gas enriched according to the Lowe process had the drawback of containing a very large quantity (30 per cent.) of carbonic oxide; but it was thought that this might be reduced to 10 per cent. by the Van Steenbergh system. If this could be done, water-gas manufacture might be employed in a considerable number of works, to the utilization of the coke which is in many cases found to be so difficult to dispose of. All the processes, the President pointed out, were of value from an economical standpoint, and if they were adopted, it would be rather on account of their commercial importance than their technical advantages; and in the gas industry it was the commercial question which certainly took the first place.

The most delicate, as well as the most important part of a gas manager's duties seemed to the President to be to keep as nearly constant as possible the ratio of the prices of raw material and those of the principal residual products. He was perfectly well aware that this was not always easy; and he very much feared that in the future it would become more and more difficult. The price of coal, unfortunately, did not depend upon them; and in France, he might add, it did not rest with the mining companies. It was, in fact, dominated by the figure at which English coals stood, which was the true regulator of the European market. In connection with this subject, he said he thought there might be a combination of companies in certain districts, for the purpose of buying coal on a large scale for the undertakings comprised in that particular area; and he expressed the belief that this would help to keep prices at fairly level figures. This had been done in the North of France and in Normandy; and it had given general satisfaction. Passing from the price of the raw material to that of its principal residual product, M. Melon pointed out that the latter does not depend upon gas managers any more than the former; yet he thought it must be admitted that in this matter their action might be a little more decisive. Much had been done to extend the use of coke; but a great deal still remained to be accomplished. In this respect, also, the combination of the gas undertakings in the same district had been attended by results to which attention could not be too often drawn. For several years past an example had been set by the North of France and Belgium; and the understanding come to between the directors of the various companies had not only prevented the lowering of prices, but had actually raised current rates, which were too low. It was possible for all their colleagues to do likewise; but, unfortunately, he had reason to believe that the system was not carried out in many districts. He could mention several towns where difficulty was experienced in disposing of coke, because that which was produced in an adjacent town was sold at a low price. Local circumstances were not always to be blamed for this; for in many cases the immediate cause lay with the middlemen whom it was thought necessary to employ, and who often passed by important markets, and overburdened their neighbours, in order to dispose of their coke. This was a proceeding which would some day turn against those who were guilty of it. They ought to adopt frankly every means of working together for the common good.

The President next alluded to the recent establishment of the Professional Syndicate of the Gas Industry. The first Syndical Chamber was appointed on the 5th of May, and comprised 24 members, representing the principal gas companies of France. Their first meeting took place on the 23rd of May, in Paris, when the Executive was constituted as follows: *President*, M. Paul Mallet; *Vice-Presidents*, MM. Alavoine, de Lachomette,

and Melon; *Secretaries*, MM. Delahaye and Béglet; *Treasurer*, M. Deleury. This Syndicate, he explained, was a second incarnation of the Société Technique; and its objects were to take up and deal with matters affecting the gas industry which could not well be undertaken by a purely technical society. M. Melon fully explained the legal position of the Syndicate; and he added that it might be expected that there would be connected with it a permanent central organization, and an office for information. Their colleagues in the provinces had been very desirous of having such a Syndicate; and its establishment had given them much satisfaction.

The President then proceeded to discuss various questions which have lately arisen, affecting more or less directly the gas industry. Taking first the electric light, he said that it was developing in nearly all the most important towns; and gas managers would have no reason to complain of this, were it not for the fact that this system of lighting was too often introduced in defiance of the liberal contracts made by gas companies with municipalities. Numerous lawsuits had been the result. The past year had, however, witnessed the establishment of principles of jurisprudence which would henceforth effectually regulate the respective relations between the two parties. This had been done by a remarkable decision of the Council of State, which dealt with the subtle distinctions made use of by certain towns that were trying to break from their agreements.* The decision was such as might have been expected in a country of good faith, where, in the end, truth always triumphs over the cleverest sophisms. It had been stated, in interested quarters, that the Council of State had killed electricity; but his hearers knew well this was not the fact. If, as the result, municipalities had to entrust electric lighting to the gas companies, it would be to the greatest advantage of electricity itself; for those companies had acquired an experience as to what light was wanted which could not be possessed by their younger rivals. To this was added prudence in the use of invested capital which those who so boldly launched out in business as some of their competitors had done, could not possibly possess. The gas companies would produce the electric light—not under protest, but willingly—wherever there was a real want to be supplied, and where the selling price was such as would allow of proper interest upon the invested capital. He knew that this was the gravest reproach brought against gas companies. They had the desire—possibly it was a ridiculous one—to make money by selling the electric light; whereas their rivals were satisfied with losing it. They were welcome to do so; but let the gas companies be ready, when the time came, to step into their places.

The next matter dealt with by the President was the question of reducing the duty on petroleum—a subject which has occupied the attention of gas managers in France since December last. All the French lighting industries were, he said, threatened by a scheme of opposition, presented under the guise of a democratic measure, at the very time when the Chambers had shown their wisdom by elaborating a general tariff of customs duties protecting national labour and national production. Were, he asked, the interests of the producers of colza, the candle makers, the gas companies, and the coal merchants, of less importance than those of the spinners in the North or the vintagers in the South? Why, then, abolish the duty on foreign produce? Was there really a democratic interest in such a measure? What value could there be in the arguments adduced with regard to the light of the poor and the use of petroleum-engines? All these questions would necessarily occupy the minds of those who were interested in gas undertakings; and therefore the Committee of the Society had supported the formation of a Syndicate for the defence of the French lighting industries. This body had not been idle, but had brought together numerous supporters, and commenced, from various points, an active campaign in anticipation of the discussion which would take place in the Chambers. They need not, however, be very much disturbed as to the results which a reduction of 13 frs. per 100 kilos., or about 11 c. per litre, might have for the gas industry. It would, at the outside, effect a saving of only 5 frs. 40 c. per annum for each petroleum-lamp; and one would be justified in saying that this economy would be of scarcely any importance in workmen's homes. And the same could equally be said of the argument with respect to petroleum-engines. In fact, not one of these motors is to be found in Belgium, Germany, or Switzerland; and the lowering of the price would not cause them to be used in France. He had had the curiosity to ascertain how many gas and petroleum engines there are in use in Belgium; and he found the numbers to be as follows: Gas, 627, representing 2207 horses; petroleum, one only, at Antwerp. Most of the so-called petroleum-engines were generally worked by means of gazoline. It was possible, he remarked, that these engines might, in the future, be made applicable for certain purposes; but it would be almost exclusively in remote country places, for in towns, whatever might be the price of gas, they would not be able to compete with motors worked by that agent. If it could be shown, then, that neither the light of the poor man nor the engine of the small-power user would be very greatly affected by the reduction of the duty on petroleum, it might be hoped that the authorities would consider those essentially French industries which would be ruined if the project were carried out. It had been calculated that every time a ton of petroleum took the place of 3000 cubic metres (about 106,000 cubic feet) of gas, 11 tons of coal were rendered useless; and M. Salanson told the members last year that the consumption of petroleum in France had increased from 58,900 tons in 1878 to 184,100 tons in 1889.

The questions just discussed naturally led the President to deal with the subject of strikes; and with this he closed his address. Strikes were, he said, likely to assume much greater importance in regard to the industrial organizations of the present day; and they would affect the various prices of productions in a manner which it was necessary to anticipate as much as possible. As far as their effect on the gas industry was concerned, they might be divided into three classes: (1) Strikes of employees in gas-works; (2) strikes of miners; and (3) strikes of workmen or officials on railways. He thought the first class were those which gas managers had to fear least. There was, of course, always about them the painful characteristic of a struggle, which left behind it serious losses. But alike at Lyons, at Marseilles, and at Havre the exercise of firmness and decision had rapidly overcome all the difficulties: and, financially, he did not believe the results had been serious for the companies in the places he had mentioned. It should be borne in mind that these strikes generally only affected one class of men in gas-works—the stokers; and it was sincerely to be regretted that, owing to the requirements of the industry, it was necessary to have three or four times as many of these men in winter as in summer. Strikes did not generally originate with the workmen engaged all the year round; and he thought the more gas companies could increase the production of gas in the summer time—at which they were all aiming, by developing its use for heating and motive power—the less liability would there be to strikes, on account of the larger number of hands regularly employed. It was the strikes of miners and railway officials which gas managers had to fear most; the more so because they could not take direct action against the promoters of them. One of their results was to keep up the price of coal; but another and still more serious one was to interrupt its regular delivery, and retard the renewal of exhausted stocks, owing to the overwhelming inrush of orders after the trouble was over. The strikes of railway officials were attended by precisely similar results; and the conclusions to be drawn therefrom were the same. All that gas managers could do, to guard against these difficulties, was to increase their stores as much as possible. He thought that in future a stock of coal sufficient for three winter months' consumption should be considered the minimum. This would, of course, involve additional expense; but it was unavoidable in order to ensure regularity of work. The importance which labour agitations threatened to assume at the present time was a matter of deep regret; but it would be wise on the part of gas managers to familiarize themselves with the idea that the workmen will for some time to come regard strikes as legitimate weapons, all the weight of which he will often cause to be felt. He (the President) therefore thought it would be prudent to make provision against the consequences of this condition of affairs, and, so to speak, to do it continuously.

* The decision referred to was noticed in the JOURNAL for Feb. 2 last (p. 207).

Electric Lighting for Leeds.—The Yorkshire House-to-House Electricity Company, who have acquired the right (subject to certain powers of purchase by the Corporation) to supply electricity for lighting and other purposes in Leeds hope to have their works completed by the 1st of November. The laying of mains has been commenced in some of the principal streets.

The Rhyl Improvement Commissioners and the Gas-Works.—Much speculation is rife amongst the ratepayers as to the attitude the Rhyl Commissioners will now take, having received the final decision of the Local Government Board, to the effect that they cannot allow a longer term of repayment than 30 years for the £35,000 required to purchase the gas-works; the period asked being 50 years.

Electric Lighting for Huddersfield.—The Gas Committee of the Huddersfield County Council reported at the last meeting of that body that the Local Government Board had given their sanction to the borrowing of £50,000 for the purposes of electric lighting—viz., £12,000, for the erection of the necessary buildings, to be repaid within thirty years; and £38,000 for the general purposes of electric lighting, to be repaid within fifteen years. The Brush Electrical Engineering Company have secured the contract for the work.

Rhyl Water Company.—At the recent annual meeting of this Company, the Chairman (Mr. R. J. Sisson), in moving the adoption of the report, congratulated the Directors and the shareholders on the present state of things, and said with regard to the transfer of their works to the Local Authority, they were now practically safe. If the Commissioners paid them £70,000, they would get on very fairly; but if they did not complete their arrangements, then they would have power to raise a sufficient sum to enable them to pay a reasonable and fair rate of interest to the shareholders. He thought the Commissioners had made a very fair bargain for Rhyl; and, by good management, they would be able to carry out their plans. As to the past year's working, the Chairman said there was an increase in expenses incurred by the unfortunate winter. The income, however, had slightly increased; and he believed in future it would continue to advance. The motion was unanimously carried. Dividends were then declared at the rates of 5 per cent. per annum on the 5 per cent. preference shares, 6 per cent. on the 6 per cent. preference shares, and £2 5s. per cent., free of income-tax, on the ordinary shares.

REGISTER OF PATENTS.

Gas-Engine.—Horn, W. W.; communicated from B. C. and E. W. Vanduzen, of Newport, Ky., U.S.A. No. 8032; May 9, 1891.

In carrying this invention into practice, the patentees propose to construct a bed (preferably of cast iron), above the upper portion of which is the cylinder, provided with a water jacket or casing supported upon a suitable framing, and within the cylinder a moveable piston connected to the crank-shaft of the engine in the usual manner. In the upper portion of the cylinder is a water-jacketed exploding-chamber, to which is connected the valve-chamber of the engine; and within the chamber are arranged the valves for controlling the admission of gas and air into the interior of the chamber and an exhaust port controlled by a second valve. In the upper part of the chamber is a moveable plug, having an internal chamber formed therein and a central perforation, in which is fitted a valve, provided with longitudinal channels, and formed at its lower end with an enlarged shoulder or head. Adjacent to the upper portion of the valve-chamber is a chimney, containing a flame for the ignition of the gas for operating the engine; a passage leading from the chamber within the plug to the igniting-flame. Upon the admission of air to the valve-chamber through the valve before described, the gas passes through the plug by the channels in the valve seated therein; and, issuing from the passage, it is ignited, and the flame resulting from the ignition of the gas ignites that in the valve and exploding chambers. The valves are operated from the main-shaft of the engine by cams fixed to a shaft driven by suitable gear from the shaft; the cams in their rotation operating the valve stems connected to and operating the several valves.

Open Gas Fires or Stoves.—Bird, S. V., of Balsall Heath, and Wood, J. S., of Birmingham, No. 8983; May 27, 1891.

This invention, relating to open gas fires or stoves, consists: (1) In providing them with exterior or front framings, composed of wood or other like materials, which may be embellished or ornamented in any desired way, so that they may be made *en suite* with the furniture of the room wherein the fire or stove is fitted; (2) in mounting, fitting, and arranging the fire, or metal enclosure constituting the fire-box, and wherein combustion takes place, to the back of, or behind, the exterior framing; (3) in providing the fire aperture or apertures within the wood framing or enclosure with a moveable and fitted panel, which covers screen-wise the openings in warm weather, when the stove is not required to be used; (4) in the construction and formation of the backs and upper parts of the fires; (5) to a new form of heat absorbent and radiator; and (6) to means for adjusting the fuel in the channels, cellular formations, or undulations of the slab or back of the fire.

Gas or Vapour Engines.—Day, J., of Bath. No. 9247; June 1, 1891.

This invention refers to a gas or vapour engine capable of an impulse at every revolution. It consists of a cylinder provided with a piston and means at the back end for obtaining the ignition of the explosive charge when it arrives in the back part. The front part of the cylinder is of such a cubical area as to conveniently contain a charge of air and gas or vapour, when these were drawn in by the back stroke of the piston through a series of holes, covered by valves. The air and gas may be drawn in in such manner that they impinge on one another when coming in, and thus form a proper mixture. Communication between the front and back ends of the cylinder is effected by suitable passages, the ports of which are opened and closed by the piston when it reciprocates. On the piston commencing its forward motion, the charge of air and gas (drawn in on the previous stroke) in the front part of the cylinder is compressed; and when the piston is nearly at the end of its outward stroke, an exhaust port in the back part of the cylinder is opened, and the products of combustion escape. Then, as soon as the exhaust port is open, communication with the front part of the cylinder is established; and the new charge, being under compression, is allowed to pass by the piston to the back part of the cylinder, where it is further compressed and ignited, driving the piston forward until the exhaust-port is opened. In consequence of the construction of this engine, it will run in either direction by simply turning the fly-wheel the right way on starting.

Union Gas-Burners.—Hislop, G. R., of Paisley, N. B. No. 12,505; July 23, 1891.

This invention was referred to by the patentee in the paper he read before the North British Association of Gas Managers last year; and on the same occasion, he exhibited a specimen of the burner in question. The object of the inventor is to construct union gas-burners in such a manner as to render the angle of inclination of the holes (as also the angle of impingement of the gas-jets) adjustable in relation to each other and to any required degree.

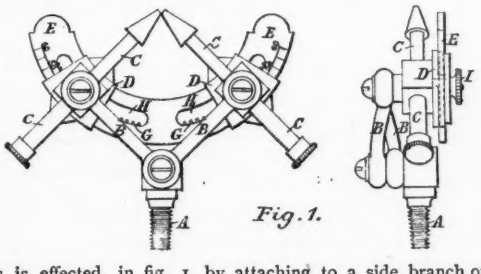


Fig. 1.

This is effected, in fig. 1, by attaching to a side branch on the screwed nipple A the lower ends of two hollow arms B, whose upper extremities are each connected to a separate inclined burner tube C, carried by clamps D on a quadrant E; the degree of angularity of the burner tubes relatively to each other being adjusted by spur-wheels (not shown) geared with racks G made in radial slots H in the quadrant or plate. The spur-wheels are turned to regulate the positions of the tubes C by thumb nuts I secured on the outer ends of their spindles, which pass through the back plates of the clamps. Scales are marked on the quadrant, to indicate the degree of angularity.

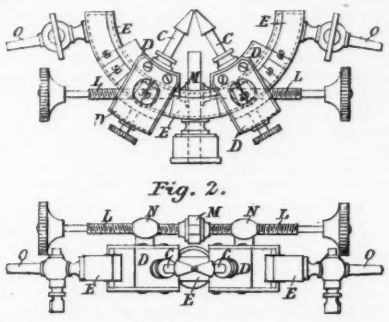
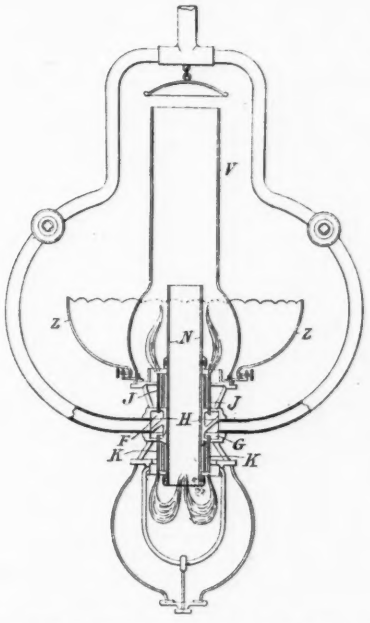


Fig. 2.

Fig. 2 illustrates a modification of the arrangement, wherein the hollow arms B are dispensed with, and the quadrant E acts as a receiver for the gas from the gas-pipe, whence it is distributed to the burner tubes C through the upper parts of the clamps D. The clamps embrace the upper surface of the box-shaped quadrant E; and they are packed gas-tight thereon at their ends by strips of leather. Within the length covered by the travel of each clamp, a hole is made on the upper surface of the quadrant, through which the gas passes outwards to the burner tubes; these being connected to the tops of the clamps. The adjustment under this arrangement is effected by a screw L, guided at M, and having a right and left hand thread upon it—one thread passing through a nut N attached to one clamp, while the other passes through a like nut connected to the other clamp. Thus, by turning the screw from either end, the angularity of the burner tubes relatively with each other is varied; the degree of angularity being indicated on a scale (on the quadrant), which is seen through openings in the front plates of the clamps. The quadrant has nipples or branches O, furnished with stopcocks for the connection of a pressure-gauge when using the burner for gas-testing or photometrical purposes.

Gas-Lamps.—Zeitschel, B., of Berlin. No. 5226; March 16, 1892.

This invention (as shown by the engraving) relates to a gas-lamp having two distinct flames; one burning upwards and the other downwards.



The gas-supply pipe communicates with two branch-pipes in the which cocks are inserted, so that gas may be supplied through both branches or only the one. The lower ends of the pipes are connected to the upper half F and the lower half G respectively of the gas-chamber H. The latter is an annular space, divided by a partition. A series of tubes J placed in a circle leads upwards from the chamber F; and a series of similar tubes K leads downwards from the chamber G, whereby two ring-burners are formed. Through the axis of the burners is passed an escape tube N, extending to such a height above the upper burner that the upper flame is not influenced by the draught caused by the gases of combustion from the lower flame moving upwards through the tube. The lower flame burns within a closed chamber (formed by the globe), closed on top by a plate provided with an annular extension and with holes placed in a circle close to the orifice of the tubes K. The space between the tubes K and the inner tube N is, however, left free. The combustion chamber of the upper flame is closed at the bottom by a plate, provided with an annular extension and with holes placed in a circle close to the orifice of the tubes J; the space between the tubes J and central tube N being also left free. On the plate rests the glass

chimney V, concentrically with the tube N. At the bottom end of the tube N, is secured a metal ring by means of countersunk screws; and a similar ring is fixed immediatey above the upper burner. These two rings act upon the flames as spreaders. To the upper plate is also secured a ring adapted to receive and support the shade Z.

Roasting and Grilling by Gas.—Goehde, R., of Berlin. No. 12,508; July 23, 1891.

This invention relates to ovens for roasting meat by gas; and its object is to provide the oven with appliances which allow it to be adapted at will either to the operation of frying, broiling, or grilling.

For this purpose, there is arranged within the oven and above the gas-burners a plate, having at its back end a transverse strip hinged with one edge to the back wall of the oven, and with the other edge to the plate. Near the hinge (at the front edge of the plate), lugs are provided; while to each side wall of the oven a ledge is fixed at about the same height as the back hinge, so that the plate and the strip may rest with their lugs on the ledges. There is also a projection on each side wall of the oven, arranged in such a manner that, if the hinged strip is turned up vertically, the plate may be placed with its front lugs on the projections, so as to be then supported horizontally by the strip and the projections in a position above the first one by an amount equal to the width of the strip. When the plate is in its lower position (close to the burners), a frying-pan may be placed on it; the pan then receiving the full heat from the gas-flames. When, however, the plate is raised into its upper position, and supported as stated, the ledges on which it had rested become free for the introduction of a gridiron whereon to broil meat; the plate under these conditions serving to reflect the heat from the gas-flames on to the top of the meat, and so close the pores and prevent the escape of its nutritive elements.

Manufacturing Illuminating Gas.—Laurarre, C. B. de, of Biloxi, U.S.A. No. 6362; April 1, 1892.

This invention relates to a method of producing illuminating gas, consisting in first admitting steam into a retort, passing the gases from decomposition thus produced into a main cooler or condenser; then diverting the gases from their original course to a main cooler, and passing them intermediately first from the retort into an auxiliary cooler or condenser, then from the latter into a carburettor, and then passing the carburetted gas from the carburettor into the main cooler. Then again changing the direction of the gas, and passing the gas from the retort directly into the carburettor, passing the carburetted gas from the carburettor into the purifier, and from thence into the main cooler; and finally diverting the course of the gas from the carburettor, admitting the oil from the carburettor into the retort (the oil being first commingled with the steam which enters the retort) passing the hydrocarbon gas obtained in the retort into an auxiliary cooler and then into a purifier, and thence into the main cooler, and finally drawing from the main cooler the gases admitted thereto by the four successive steps described into a suitable gasholder.

Gas Making Apparatus.—Collins, C. R., of Philadelphia, U.S.A. No. 7079; April 12, 1892.

This invention relates to apparatus for the manufacture of carburetted water gas; and it has for its object to provide apparatus in which the process of carburetting and fixing the water gas may go on continuously, while the generator forming part of the apparatus is run intermittently—alternately making producer gas, which is used for heating the fixing chambers, and water gas, which is carburetted in the chambers.

Fig. 2.

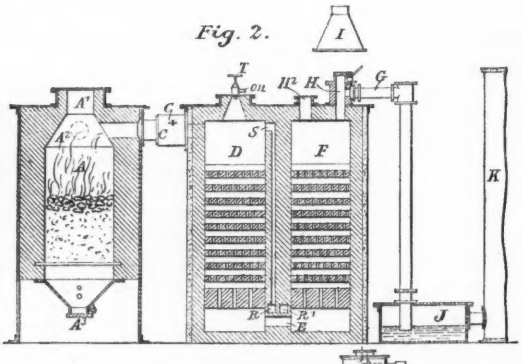


Fig. 4.

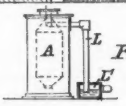


Fig. 5.

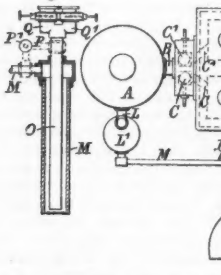


Fig. 1.

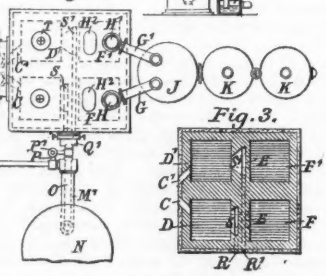


Fig. 3.

A is the generator (of the usual construction), having a charging opening closed by a lid A^1 and a gas exit passage A^2 near its top (indicated by a dotted line, because it is really on the side of the generator which is cut away). A hinged gate A^3 is provided at the bottom of the generator for the removal of the ashes; and below the grate an air-blast pipe and steam-pipe enter it. A conduit B also opens from the upper part of the generator; and leads into a box which communicates with chambers from which, in turn, run two conduits or flues C C^1. These conduits lead respectively to two separate and independent fixing-chambers, or sets of fixing-chambers, in which the gas is carburetted and fixed. As shown, each such chamber consists of a chamber D or D^1, in which provision is made for introducing the carburetting material with an oil injector T at the top. The chambers D and D^1, the patentee prefers, should be partly filled with checker-work, and opened at their bottoms, through conduits E, into fixing-chambers F and F^1 respectively; these chambers being also filled with checker-work as shown. From the chambers F and F^1, conduits H G and H^1 G^1 lead to a wash-box J, which, in turn, communicates with scrubbers K, from which the gas is led to the place of use or storeage.

Returning again to the generator, another conduit L leads from the opening A^2, and through a seal box L^1 and conduit M M^1, to a gas receiver or relief holder N; and from the receiver, a pipe O leads, branching at its end at Q Q^1, and communicating with conduits or flues R and R^1 formed in the masonry of the superheating chambers. The flue R communicates with the vertical flue S, which opens into the top of the chamber D; and the flue R^1 communicates with the vertical flue S^1, which opens into the top of the superheating chamber D^1. Valves are provided for controlling the passage of gas from the receiver to the chambers D and D^1. In order to economize the heat of the gas coming from the generator to the receiver, the delivery-pipe O of the receiver is made to pass through the pipe M^1; the pipe O being thus jacketed with the hot gases coming from the generator; and it is also preferred to provide a bye-pass P, connecting the pipes M and O as shown—the bye-pass being furnished with a valve P^1 by which it can be opened, and closed at will. This valve can, if desired, be an automatic valve, which will open whenever a determined amount of pressure of gas is accumulated in the receiver. H^2 indicate openings leading into the chambers F F^1 for cleaning them.

The operation of the apparatus is as follows: A fire being lighted in the generator and fuel supplied thereto, air is forced through the fuel, and the producer gas thus made is allowed to escape through the conduit B and conduits C C^1 into the two sets of carburetting and fixing chambers, in which it is burned in order to heat the chambers. The products of combustion are allowed to escape by opening the valve at the top of the pipes H H^1, when they will pass through the pipes into the stacks I placed above them. In starting the apparatus, one or both sets of carburetting and fixing chambers can be heated at the same time. When the fuel in the generator is sufficiently ignited, the air-blast is turned off. Steam is then admitted into the bottom of the generator; and this, passing through the fuel, is converted into water gas. The valve in C having been previously closed, the water gas passes from the generator (through the conduit made up of L, L^1, M, and M^1) to the receiver or relief holder N. The valves in Q are allowed to remain closed until a sufficient amount of water gas is collected in the relief holder; and in the meantime, if more than one blast is required to accumulate the desired quantity of water gas, the valves in C, or one of them, are opened, whenever the steam is turned off and the air blast turned on to the generator.

A sufficient quantity of water gas having been accumulated in the receiver, and the carburetting and fixing chambers having been raised to a proper temperature, the operation is continued as follows: The valve in Q is opened, the valve in Q^1 closed, the valve in C^1 opened, and the valve in C closed. The air-blast being now in operation in the generator, the producer gas passes through the chambers D^1 and F^1 and escapes through the conduit H^1, which is opened at the same time with the valve in C^1—the gases, of course, being burned in the chambers D^1 and F^1 while passing through them. At the same time, water gas passes from the relief holder N through the chambers D and F; carburetting material being introduced in the chambers as described, and the carburetting gases escaping through the pipe G to the washer and scrubbers—the valve at the top of the pipe H being, of course, closed. When the blast of the generator is continued long enough, the valve in C^1 is shut; the steam again turned into the generator; and the water gas formed in it escapes through the conduits L and L^1 and M and M^1 to the receiver N. When this run of water gas is continued sufficiently long, the steam is shut off, and the air blast is again admitted to the generator. The valve in C^1 is previously closed, the valve in C opened, the valve in Q closed, and the valve in Q^1 opened; and at the same time the valve at the top of the pipe H is also opened. The producer gas then passes through, and is led into it from the generator. Independent connections from the conduit lead from the receiver to each set of carburetting and fixing chambers; and valves situated in the conduits are provided for governing the course of the gases.

[This is the apparatus specially referred to in the paper read by Mr. Goulden at the last meeting of the Institution of Gas Engineers.]

APPLICATIONS FOR LETTERS PATENT.

10,745.—The Manchester Oxygen (Brin's Patent) Company, Limited, and W. M. Jackson, "Manufacture of oxygen." June 7.

10,751.—Brooks, J. W., and Perks, H., "Repairing or joining water, gas, and other such pipes." June 7.

10,806.—Goldsmith, J. M., "Portable gas-generating apparatus." June 7.

10,898.—Jones, W. E., and Bosworth, H. H., "The 'Victor,' gas motor engine." June 9.

10,933.—Birnie, W. J., "Manufacture of hydrogen gas for illuminating and heating purposes." June 9.

10,947.—Hawkyard, J., and Braddock, J., "Station gas-governors." June 10.

10,996.—Higginson, A., "Regenerative gas heating and cooking apparatus." June 11.

11,001.—Peebles, D. Bruce, "Gas-governors." June 11.

PARLIAMENTARY INTELLIGENCE.

PROGRESS OF BILLS.

The following further progress was made with Bills up to the prorogation of Parliament (June 28):—

Bills reported, read the third time, and passed: Electric Lighting Orders Confirmation Bill (No. 5); Water Orders Confirmation Bill.

Bills Royal Assented: Bexhill Water and Gas Bill; Birmingham Corporation Water Bill; Bournemouth Improvement Bill; Bradford Corporation Water Bill; Brynmawr and Abertillery Gas and Water Bill; Electric Lighting Orders Confirmation Bills (Nos. 4, 5, and 6); Exmouth and District Water Bill; Gas Orders Confirmation Bill; London Water Bill; Newcastle-upon-Tyne Improvement Bill; Rhyl Improvement Bill; Rhymney Valley Gas and Water Bill; Stamford and St. Martin's Stamford Baron Gas Bill; Swansea Corporation Water Bill; Uttoxeter Water Bill; Water Orders Confirmation Bill; Western Valleys (Mon.) Water (Gas Purchase) Bill.

The following Bills are in suspense until the meeting of the new Parliament, when they will be proceeded with at the stage reached by them at the time of the dissolution:—

Blackpool Improvement Bill (read a second time in the Commons, and committed).

Ilkley Local Board Bill (passed by the Commons, and waiting for second reading in the Lords).

Leeds Corporation Bill (read a second time in the Commons).

London County Council (Subways) Bill (waiting for report from Select Committee of the Lords).

LEGAL INTELLIGENCE.

STAFFORDSHIRE QUARTER SESSIONS.—Friday, July 1.

(*Before Mr.* T. F. TWEMLOW, *Chairman, and a Bench of Magistrates.*)

The Assessment of the Birmingham Corporation Gas-Mains.

The hearing of the appeal by the Birmingham Corporation against the assessment of their mains at Harborne by the Assessment Committee of the King's Norton Union was concluded to-day. A report of the previous proceedings appeared in the JOURNAL for April 26 and May 24.

Mr. DANCKWERTS and Mr. KETTLE appeared for the appellants; Mr. YOUNG, Mr. PRITCHETT, and Mr. SHAKESPEARE for the respondents.

The evidence on behalf of the Assessment Committee having been concluded,

Mr. YOUNG addressed the Court for the respondents. He said that he should pass over all points of minor importance, and deal with the matters upon which there was a serious divergence of opinion between the experts called on both sides. Of course, the most important difference was in reference to tenant's capital, which Mr. Jones put at £365,000 on behalf of the Corporation, and which his witness (Mr. Mason) calculated at £250,000, of which £108,000 was represented by shares and working capital. These figures were not based on mere theory, but upon the accounts from the books of the Corporation. As to tenants' allowances, 17½ per cent. had no doubt been the figure allowed in many cases, and he would not further dwell upon it. With regard to statutory allowances—which the respondents put at £55,022—Mr. Jones claimed £4634 for contractor's profits on the landlord's repairs. This was the first time such a claim had been made; and the appellants had claimed it twice over by the 15 per cent. on landlord's outlay and 15 per cent. on his chattels. In the sinking fund claimed by Mr. Jones, there was an important matter of principle raised, because he admitted that he had not returned the life of the mains at their natural length, owing to their having to be replaced before worn out, on account of the extension of the business. He also claimed an annual fund of £11,280 for the renewal of meters, in addition to the agreed figure of £6286 for their repair and renewal; but he was informed that the average cost of repairs and renewal since the Corporation took over the works was only £7757, and that included substantial improvements in meters. With the £80,000 payable on account of annuities, and the £4000 sinking fund, the Corporation had to find £84,000 before they could deal with any profit. No one would say that the Corporation ought to let their works for that sum—just enough to pay liabilities incumbent upon them by the terms on which they acquired the undertaking. Assuming the Corporation claimed 1 per cent. on their two millions over and above the £84,000, the 1 per cent. represented £20,000, which, with the £84,000 made £104,000. The rateable value of the works was agreed at £40,000, which left £64,000 for the mains. According to Mr. Jones and Mr. Mason, Harborne's share was 1 per cent., which amounted to £640, which would be the rateable value, because nothing could be deducted from that. Even leaving out the £20,000, there was a rateable value of £440, compared with the £400 appealed against. He gathered, from what had been said, that the appeal would never have been made but for the fact that there was a prospect of the rates being increased in Birmingham; and therefore Harborne, which was in no sense associated with Birmingham for rates, had been made to stand the racket of the appeal, with an expense which was enormous to Harborne though a mere fleabite to Birmingham.

Mr. DANCKWERTS, in summing up the case for the appellants, said that *primâ facie* it did appear that the Corporation should not incur such heavy expense in fighting so small a matter. But this appeal would have an effect upon the rest of the undertaking of the Corporation. Why they selected Harborne in which to fight the first battle in the campaign, he did not know. The learned Counsel proceeded to argue that, while the evidence of his valuers was, with few small exceptions, based on facts, the evidence on the Harborne side was founded on conclusions arrived at on a wrong theory. He strongly criticized the evidence of Mr. Mason, whose cross-examination, he contended, showed that his evidence was full of mistakes—indeed, it would have taken him (the Counsel) months to have exposed all these errors; and he was astonished that Mr. Young should have relied upon one of those fallacies. He said that the Corporation had to find some £80,000 a year to pay annuities and sinking fund; and therefore it must at least receive a rent to that amount. Did ever the Bench hear a more stupid observation in their lives? What did that £80,000 represent? It represented payment in respect of annuities for capital raised and sinking fund. What was that capital? Was it landlord's capital? No, it was both tenant's and landlord's, because it represented the purchase of the hereditaments themselves and the goodwill. That had not to be found out of rent, but out of the whole receipts of the concern—the tenant's and landlord's profits. The real differences between the valuers arose on three points—the tenant's capital, repairs, maintenance and renewals, and insurance. The greatest difference was on the tenant's capital. Mr. Jones, for the Corporation, put it at £365,785; Mr. Valon and Mr. Mason, for Harborne, put it at £257,000 and £250,000 respectively. Then they differed as to interest. The Harborne valuers absolutely gave no acceptable reason why they departed from the 17½ per cent., which from time immemorial had been the tenant's interest allowed in every work on valuation of concerns of the kind in question. The point where surveyors always differed was as to the amount of tenant's capital on which profit should be allowed. The tenant's profits were fixed upon the amount of capital which he invested. Having taken his profits out of the business, he had to pay his rent to the landlord (which was the gross rateable value); and if the accounts showed a deficit, then it was evident he was paying too much rent, and therefore too much in rates. In Mr. Mason's calculations the hypothetical tenant had a deficit of £70,000—including his profits of £32,000; and therefore Mr. Mason was charging the tenant too much for rent and rates. So with Mr. Valon's figures; and it was consequently clear that they were calculated on a wrong basis. The learned Counsel handed in to the Bench the tabulated statements upon which he based his arguments; and he claimed that the figures of Mr. Jones and Mr. Matthews conclusively proved that the mains had been over-assessed.

The Bench, at the conclusion of the learned Counsel's speech, retired for five minutes. On returning into court,

The CHAIRMAN said that, as he had before stated, the whole question was one of calculation and figures; and the Court were unanimously of opinion that no case had been made out to justify them in interfering with the discretion of the Assessment Committee.

The assessment was therefore affirmed, with costs.

The Alleged Theft of Coke at Ramsgate.—At the Sandwich Quarter Sessions, Frederick Yates and William and Frederick Drayson, who a few weeks ago were committed for trial on a charge of conspiracy to fraudulently obtain coke from the Ramsgate Gas-Works were acquitted.

Exhibitions of Gas Appliances.—An exhibition of the various gas stoves and appliances manufactured by Messrs. Fletcher, Russell, and Co., Limited, of Warrington and London, has been held at Mossley. Great interest was displayed in the cooking demonstrations by Mrs. H. M. Young, which were given twice daily. A similar exhibition in the town last year was very successful; no less than 70 cooking-ranges being then hired or purchased. On Thursday, the 23rd ult., and the two following days, an exhibition of gas-stoves and other appliances, furnished by Messrs. Richmond and Co., Limited, of Warrington and London, was held in the Town Hall, York Town; free cookery lectures being delivered by Miss E. E. Golding.

Sales of Shares.—At Newmarket, on Monday last week, Messrs. Griffiths and Chennell sold £205 ordinary stock in the *Victoria Newmarket Gas Company, Limited.* It was put up in seven lots of £25 each, and one lot of £30. Six of the former fetched £60 each, and the remaining one £61; the £30 lot realizing £75. On the same occasion, ten £10 shares in the *Newmarket Water Company, Limited,* fetched £185.—At a sale by auction at Newcastle last Thursday, 15 £5 shares in the *Newcastle and Gateshead Water Company,* now represented by £75 stock, realized £167 15s. per cent.; 50 £5 shares in the *Consett Water Company* (fully paid) produced from £9 2s. 6d. to £9 10s.; 20 £5 shares in the same Company (£3 paid), fetched £5 17s.; 30 ordinary "A" £10 shares in the *Cleveland Water Company* (fully paid) sold at £13 7s.; and 5 £25 shares in the *Weardale and Shildon Water Company* (fully paid) realized £30 5s.——At Salisbury recently 40 £10 shares in the *Fisherton Anger and Bemerton Water Company* produced from £16 to £16 7s. 6d. each.

Extended Use of Coal-Conveying Plant.—The North-Eastern Railway Company are building a new retort-house fitted with inclined retorts; and the New Conveyor Company, Limited, have received the order for the coal-breakers, and also for elevators and conveyors on Little's patent noiseless steel wire-rope design. The elevators, Mr. Little states, will deal with either the coal or the coke—an arrangement which he thinks is novel in gas-works. The same Company have been entrusted with the order for coal-hoppers, a breaker, and auxiliary plant, to work with Little's conveyors and elevators, for the retort-house, fitted with a double bench of inclined retorts, which is being erected at the gas-works of the Leigh Corporation, under the supervision of Mr. A. F. Fletcher, the Engineer and Manager. At a meeting held last Friday, the Gas Committee of the Burnley Corporation accepted the Company's tender for a large installation of conveyors, to distribute the coal automatically to two long benches of retorts. The Company also have in hand orders for coal-breakers for the Bedford and Gateshead Gas-Works. We learn that the Directors have completed their special plant for the manufacture of the appliances and general ironwork to act in conjunction with Mr. Little's machines. We are informed that tests recently carried out have demonstrated that a push-plate coal conveyor, or a tray conveyor for coke, 12 inches wide, of that gentleman's wire-rope design, possesses a capacity of 25 tons per hour; being double that of the old-fashioned American chain conveyors.

MISCELLANEOUS NEWS.

SOUTHEND GAS-WORKS.

Commencement of a New Gasholder-Tank.

The Southend Gas-Works presented an unusually gay appearance last Tuesday, when a party of ladies and gentlemen assembled to witness the formal commencement of the wall of the new gasholder-tank which is being constructed for the Company by Messrs. J. and H. Robus, of Bucklersbury, E.C. Among those present were the Chairman (Mr. C. Woosnam) and the Directors, the Secretary (Mr. C. J. Dobson), the Engineer and Manager (Mr. F. Clark), and Mr. W. H. H. Broadberry, who managed the works for nearly twenty years after they were started in 1854. A number of the visitors having descended the trench to the spot selected, the ceremony of laying the first brick was gracefully performed, under Mr. Henry J. Robus's guidance, by Mrs. C. Woosnam; the announcement that the brick had been "well and truly laid" being received with hearty cheers. Other bricks were then placed in position by several of the ladies present; including one by the contractor's daughter (Miss Rose Mary Robus), who presented to Mrs. Woosnam a silver trowel, bearing a commemorative inscription, and a basket of very fine roses. The party then partook of luncheon in a marquee on the ground; Mr. Woosnam presiding. In asking the visitors to drink success to the work just commenced, he said it had not been undertaken a day before it was wanted; and, all going well, it would be finished in November. Its completion, with the holder (which will be a two-lift one, and contain 300,000 feet of gas), would relieve their Engineer of considerable anxiety. Passing on to refer to the progress of the Company, he said that when they began they had a capital of £2000; and a 5000-feet holder was sufficient for their requirements. Subsequently they put up one of 20,000 feet; and the next step was to one of 100,000 cubic feet capacity, which the Directors thought would be ample for their needs. But more storeage room was necessary, and the tank and holder now in progress were determined upon. He also gave a few particulars as to the financial progress of the concern. Going back to the year 1855, he said that from May to December (with gas at 10s. per 1000 cubic feet) they took £61; and their first dividends were paid in 1857. By 1864 or 1866 they were able to pay their full maximum dividends. In the Act the Company had recently obtained, they would have 10 and 7 per cent. on their capital, with a standard price of 4s. 6d. and the sliding scale. During the parliamentary inquiry he had been asked if he was disposed to part with the concern. He certainly was not; and he intended to do all in his power to ensure its continued success. The toast having been heartily received, a few others (including "The Contractors," to which Mr. Robus suitably responded) were proposed and duly honoured, and the company separated. The tank excavation as completed is 103 feet in diameter (92 feet from face to face of the brickwork) and 32 feet deep in all, or 25 feet to the top of the rest stones. The brickwork will be 3ft. 4½in. wide at the bottom, and 2ft. 7½in. wide at the top. The bottom of the tank is formed of 2 feet thickness of puddle, with 9 inches of concrete upon it. There has been some difficulty with the excavation; a great quantity of running sand having been met with. A sump-hole 30 feet deep has been sunk, and a pair of 8-inch rocking pumps draw off the water. The tank guides and rests for the columns are of cast iron. The inlet and outlet pipes are of wrought iron, and are 14 inches and 16 inches in diameter respectively. The work is being carried out under the supervision of Mr. H. Cook, Messrs. Robus's representative; Mr. R. Child having charge on the spot. The holder will be put up by Messrs. S. Cutler and Sons, of Millwall and Westminster.

LONDON COUNTY COUNCIL.

The Proposed Electric Lighting of the Thames Embankment.

At the Meeting of the London County Council last Tuesday, the Highways Committee reported that their attention had been directed to the defective lighting of the Victoria Embankment, and especially of the carriage-way; and for some time past they had had under consideration the desirability of substituting electricity for gas as the illuminant. In connection with this substitution, the first question that presented itself was what method should be adopted to provide the supply of electrical energy. Three courses appeared to be open—viz., (1) to obtain the supply from the companies authorized to supply within the areas in which the Embankment is situated; (2) for the Council to lay the mains and provide and fix the lamps, and then to obtain the supply from one of the companies; and (3) for the Council to install the necessary plant on their own land, and to light the Embankment by means of an independent installation. The third course appeared to the Committee to be the proper one to take. The first capital expenditure would, they said, be greater, but the cost of maintenance would probably be less; and the adoption of this course would accord with the principle which had been affirmed by the Council of the carrying out of work by their own staff when practicable. Should the Council decide to adopt the electric light as the illuminant for the Embankment, the Committee proposed that lamps of from 1000 to 1200 candle power should be placed in the centre of the road at about 50 yards from each other. Something like 50 of these lamps would be required for the carriage-way, a few of which at important points might be of a higher illuminating power; and the supply of the electric light might also be extended to the existing lamps on the parapet walls, and, where necessary, to those on the footways. The generating power required for this installation might conveniently be placed upon the land belonging to the Council under the Charing Cross railway bridge. Upon the question of cost, the Committee were advised that the capital expenditure, if the above arrangement were adopted, would probably not exceed £10,000; while the cost of maintenance, including depreciation, repair, and interest on capital, and also providing amply for labour, would not exceed the sum of £2000 per annum. They accordingly recommended that, subject to an estimate being submitted to the Council by the Finance Committee it be referred to the Highways Committee to carry out, at a cost not exceeding £10,000, an electric installation, with the necessary plant, for the lighting of the Embankment. Mr. Grosvenor, on behalf of the Bridges Committee, appealed to the Chairman of the Highways Committee to establish plant upon such a scale as would permit of the bridges which abut on the Embankment being also lighted by electricity. Mr. Benn said that if Mr. Grosvenor would bring forward an additional estimate of £2500 or £3000, the Highways Committee would be very glad to join hands with the Bridges Committee, and light the bridges as well as the Embankment. After some discussion, the recommendation was agreed to, with the following addition: "And that the Highways Committee do also confer with the Bridges Committee and the Parks Committee respectively, and report whether the plant can be established on a sufficient scale to enable Westminster and Waterloo Bridges and the Embankment gardens to be lighted from the same source."

COVENTRY CORPORATION GAS SUPPLY.

The Annual Report—The Railway Siding Question.

At the last Meeting of the Coventry City Council—the MAYOR (Mr. Singer) presiding—the annual report of the Gas Committee, of which an abstract appeared in the JOURNAL for the 21st ult., was submitted.

Mr. ANDREWS, in moving the adoption of the report, said he could only express his regret that the year's trading had not been so favourable by far as in some preceding years; but if it was any consolation to the members of the Council, he could say that, so far as he could ascertain, nearly every gas undertaking in the country was in a similar position. The report stated broadly the reasons why the receipts had not been in the proportion of the increasing amount of gas consumed, and also the decrease in the price of residuals. The quantity of gas made last year was 325,000,000 cubic feet, as against 285,000,000 feet during the preceding year, which was an increase of nearly 14 per cent.; but the amount of money received was only £53,300 as against £49,900, being an increase of only 6½ per cent. To put the matter in a nutshell, they had only received 6½ per cent. more money than last year, while they had made an additional 14 per cent. of gas. The 6½ per cent. had to pay the cost of the extra 14 per cent. of gas made; consequently there was a decrease in the profits. If the previous year's prices had been maintained throughout the past twelvemonth, they would have received £1640 more for coke; £78 more for breeze; and £196 more for tar; and the difference of 1d. per 1000 cubic feet, by which the price of gas was reduced nearly a year ago, made £1000 less. In addition to this, the Committee had had to pay £1100 more for coal, and a further £1100 for labour, owing to the advance granted last year to the men. Altogether, what with the decrease in the price of residuals, the increase in the cost of coal and labour, and the reduction in the price of gas, there was a difference in the profit on the year's trading of £5000. He might say that the outlook for the current year was not so very promising. Indeed, some gas undertakings had had to increase the price of gas already. When the Corporation purchased the gas-works, the price was 3s., as compared with 2s. 9d. in London; whereas now it was 2s. 8d., as against 3s. 1d. in London. The Committee did not at present recommend any alteration in the charge; but he did not think it was improbable that, within the next three months, they might have to come to the Council and ask them to re-impose the penny taken off last year. The price of residuals, he was sorry to say, was still falling. In the past year they made £2229 profit upon tar, after paying the cost of carting and labour in connection with it; but it seemed likely that a good deal of this would be lost during the coming year, owing to the still decreasing price of tar. As the report stated, the Committee had rebuilt the No. 1 retort-house, which was erected about the year 1820; and it was in such a ruinous condition that, before it could be safely pulled down, it had to be propped up to prevent it falling. It had been made somewhat larger than formerly; and the cost of rebuilding had been paid by three instalments out of the revenue of the past three years. The retorts in this house had been set upon the inclined principle, instead of being horizontal. This new system, which was gradually coming into use, effected a large saving in labour; and, as the report said, there would be less smoke in the works. The number of inclined retorts was 72; the total number of retorts in the works being 306. There were one or two questions which had been referred to the Gas Committee, and of which he would mention the position. One was as to the future of the entire gas undertaking, upon the assumption that there would be an annual increase of 6 per cent. He might say in reference to this that the resolution was proposed by himself at the meeting of the Council in Committee; but he was not quite certain whether the 6 per cent. was not excessive. Last year they had an increase of 12 per cent.; but so far, during the present year, there had been no increase at all. The gas sold was nearly the same as in the past year; so that the growth of the consumption had ceased for the time being. He found that the average increase for the past twelve years of The Gaslight and Coke Company was 3·43 per cent.; so that it was quite possible that the increase in Coventry during the last year or so might have been a mere flash in the pan, and that the future advance would be much smaller. At any rate, the question was referred to the Committee on the supposition that the annual increase would be 6 per cent. Another matter referred to the Committee was the memorial of the inhabitants in the neighbourhood asking the Corporation to remove the whole manufacturing plant to a distance outside the city. The Committee reported on this in December last, but could not recommend that the prayer of the petition should be granted, or that the proposal should be entertained. The recommendation was adopted by the Council. The question was narrowed down to one as to the future enlargement of the present works or the building of auxiliary works outside the city. The Council might expect a report shortly upon this latter point, which was still in hand. Another question was also referred to the Committee, and would be shortly reported upon—viz., the amount of information to be furnished to the Council from time to time as to the state of the

works and the trade of the department. He might add that the amount now in the sinking and reserve funds was between £16,000 and £17,000, the whole of which had been accumulated out of the profits. This money was now invested in Consols, and was available when wanted for the payment of the purchase-money of the gas undertaking.

Mr. PULLEY seconded the motion, which was agreed to.

At a subsequent stage of the proceedings, there was a discussion on the old question of a railway siding for the gas-works.

Mr. LEE moved—"That it is desirable for the Council to consider the question of promoting a railway connection between the Nuneaton line and the gas-works." He said he was quite aware that this subject was very unpopular in some quarters; but he had drawn his proposition purposely that everyone could vote for it. At the last meeting he endeavoured to find out in what position this matter stood; but could get no definite reply. He was told by the Gas Committee that they knew nothing about it. The Council took it out of their hands and gave it to another Committee—the Gas Siding Committee. He inquired next of that Committee; but they said they were appointed to get information from an expert, and they had done so; so that they had finished with the matter. This was not the proper way that a public question should be disposed of. The subject ought to be considered in the interests of the ratepayers; seeing that 12 or 14 per cent. could be saved on the outlay, or £1700 a year.

Mr. KINDER seconded the motion.

Mr. DRINKWATER observed that this was a question which was continually cropping up; and it was time it was voted upon one way or the other. He proposed, as an amendment, that it be referred to the Council in committee. The Gas Committee had never been able to see that there would be a saving of £1700 a year.

Mr. HORTON seconded the amendment.

Mr. CALCOTT said that Mr. Lee's reference to the saving of £1700 seemed to him inconsistent with the facts of the case. He was informed that the consumption of coal during the year was 132,000 tons, and that the cost of haulage was 7½d. per ton. This only came to £4000; and he failed to see how they could conclude that 12 or 14 per cent. would be saved by the siding, and that sum amount to £1700, which would be more like 45 per cent. If the siding were constructed, he did not see where they could realize more than £400 or £500 a year.

The MAYOR said there were other contingencies besides the cost of haulage to be taken into account.

Mr. WORMELL, referring to the statement of the Engineer who was consulted, that there would be a saving of 8d. per ton, said the Gas Committee had only paid 7½d. per ton for haulage. How could they then save 8d. per ton on what they had only been paying 7½d. for?

Mr. LOUDON then proposed that the whole question be deferred until a report was received from the Gas Committee as to what alterations were proposed to be made in the works.

This was seconded, and, after further discussion, was accepted as the substantive motion, and was carried.

ELECTRIC CURRENTS AND GAS METERS AND FITTINGS.

In the JOURNAL for the 10th of May last, reference was made to some correspondence which had taken place between the Secretary and General Manager of The Gaslight and Coke Company (Mr. J. Orwell Phillips) and the Board of Trade, relative to certain damage which had occurred to gas meters and fittings in Piccadilly and Pall Mall. It may be remembered that in the former place the mischief arose, according to the report by Major Cardew, through electrolytic action; and the Company's Distributing Engineer (Mr. G. F. L. Foulger) was of opinion that the meter and fittings in Pall Mall had been injured by an escape of electric current. His report, the principal portions of which were given in the JOURNAL when the matter was noticed, was sent to the Board of Trade, who transmitted it to the General Manager and Secretary of the St. James's and Pall Mall Electric Light Company, Limited (Mr. F. J. Walker), as the alleged leakage of current was from their mains. An investigation into the case was duly made, and a report thereon sent to the Board of Trade. A copy has also been forwarded to us, together with the reply of the Board; and in fairness to the Electric Light Company, we give below the essential parts of both documents.

Mr. Walker stated the facts of the case as follows: "The gas-meter in question was placed on the top of a water-closet in the bath-room of a set of chambers at No. 56, Pall Mall, and was used to register the supply of gas to a stove in the sitting-room; the chambers being lighted throughout by electricity. The supply terminals of my Company, with the main meter, are situated in the basement of the house; and from this point the landlord's distributing wires are carried through the house for the supply of various sets of chambers. Although the fittings on these premises were put up a few years back, and are not of the most modern description, the insulation of the whole of the circuits in the house is in proper condition. We learn from the landlord that, at the time of the accident complained of, the tenant of the chambers was in his sitting-room with the gas-stove burning, and that he heard a slight report—the stove being extinguished at the same time. No notice of this appears to have been taken for some few minutes, when, on account of a smell of burning, someone went into the bath-room and found the damage as described. The gas was at once shut off. In the report of the Engineer of the Gas Company, it is stated that 'there was a small escape of gas from the consumer's fittings; and this was evidently ignited by the electric current. Our inspector informs us that he subsequently saw electricity issuing, in the form of a blue spark an inch long, from the electrical fittings at the point in question.' We are informed by the landlord that there was known to be a leakage of gas at the junction of one of the pipes to the meter; but we must protest in the strongest terms against the statement that this gas 'was evidently ignited by the electric current.' With regard to the 'blue spark' seen at the point in question, the landlord, who was present with the gas inspector at the time, explains to us that this was seen in the sitting-room, where there is fitted an ordinary Edison tumbler switch. With this switch, as with most other forms, it is possible, by moving the tumbler slowly across, or by removing the metal cover so as to place it across the switch terminals, to somewhat exaggerate the usual spark at a switch on breaking contact. We need make no further comment on this statement made by the Gas Company, which is put forward by them as evidence in support of a charge both rash and ill-considered. Had the leakage of gas been fired by an external spark, as described above, the effect of an explosion would have been visible in the room. As regards the condition of the electric circuits, the whole of the premises were tested *en bloc* for leakage on the 28th of April in the course of the usual quarterly tests, and were found to be in order. For the purposes of our inquiry, an insulation test was made on the 23rd of May, again from the consumer's terminals; and the insulation resistance of the whole of the circuits to earth was found to be 1·18 megohms. The electric fittings had not been altered or disturbed in any way. Apparently the damage was caused by firing back from the stove to the gas leak close to the meter, which then continued to burn. We are informed by the landlord that he does not for a moment think of attributing the damage in any way to the electric circuit; and, further, that when the officials of the Gas Company inspected the premises, they were accompanied by an expert engaged by them, who declared at the time, in his hearing, that he could see nothing in the electric light work that would account for the damage. He suggested that it would have been caused by firing back from the gas-stove itself—an accident by no means improbable. I am instructed, therefore, to ask, in view of the uses to which this incident has been put to prejudice the interests of the industry, that an inquiry should be held in the matter. My Company are not aware as to whether Major Cardew has already made an inspection, as in the previous instance; but they would request that an early appointment be made for him to meet Professor Kennedy, F.R.S., who has kindly consented to act for the Company in this matter." In reply to this letter, Mr. Courtnay Boyle, on behalf of the Board of Trade, informed Mr. Walker that Major Cardew had visited the premises, and had reported that, in his opinion, there was no evidence to establish any connection between the electric supply of the St. James's and Pall Mall Company and the small explosion of gas in question; and that, in these circumstances, the Board did not consider any formal inquiry would be necessary.

PLYMOUTH GAS COMPANY.

The Annual Meeting of this Company was held last Thursday—Mr. G. HENDERSON in the chair.

The report submitted by the Directors stated that, after paying the authorized half-yearly dividend in January last, there remained to the credit of profit and loss account £21,721; and they now recommended the payment of a dividend for the half year ending March 31 last of 12s. 3d. per share on the original shares, 9s. 9d. per share on the additional shares, and 9s. 3d. per share on the new shares, free of income-tax. This would absorb £5175, and leave a balance of £16,546 to be carried forward. The report further stated that, for some years past, the consumption of gas had greatly increased, rendering a considerable extension of the plant necessary; and works were now in progress which would be ready for use during the ensuing winter. To meet this outlay, a further issue of capital was required. The Directors, therefore, recommended that, under the provisions contained in the Company's Act of 1879, further capital to the amount of £7500 be issued in 750 shares of £10 each.

The CHAIRMAN, in moving the adoption of the report, said, when they considered the extremely low price—1s. 9d.—at which the gas was now being supplied, he thought they must agree with him that the accounts as submitted were very satisfactory. The expenditure had been £70,777, as against £68,900 in the previous year; and the income had been £79,555, as compared with £75,389. The principal items of expenditure were: General charge on the manufacture of gas £60,474, as against £59,264; cost of distribution £4500, as against £4895; public lighting £1176, against £948; rent, rates, and taxes £1300, against £1263; and management £2800, against £2850. The principal items of income were: For sale of gas £52,744, against £48,968; meter-rents £3300, against £3200; and residuals £22,394, against £22,022. As showing the progress made by the Company, he said that in 1858 they produced 358 million cubic feet of gas, and last year 640 millions—an increase of nearly 80 per cent. They had to anticipate an increased consumption for some years to come; and they were making arrangements for extending their mains, especially in the East-end of Plymouth. They were putting down a 24-inch main, and intended laying a 30-inch main from the Clock Tower to Stonehouse, so as to give an abundant supply of gas, not only to the Government establishments, but throughout the whole of the district. He also mentioned that their average capital expenditure per ton of coal carbonized annually was £1 16s. 11d., as against an average of £5 5s. 5d. in other provincial companies. This was one of the reasons which enabled them to supply gas at so low a figure as 1s. 9d. per 1000 cubic feet.

The DEPUTY-CHAIRMAN (Mr. R. H. Snow) seconded the motion.

Mr. R. A. BROWNING said it was very creditable to the Company to supply gas at such a reasonable rate as they did. Much of the success which had been achieved by them was, he thought, due to the Engineer. As to the coal contracts, he wished to know if the tenders were advertised, as was done by other companies. He complained that, while they gave the Chairman a pension of £400 a year and a salary of £100, they had not recognized the services of Mr. Tucker, one of their oldest collectors, who had retired from work.

THE CHAIRMAN said it was 48 years since he was first connected with the Company. The old Company were charging at that time 8s. and 9s. per 1000 cubic feet; and many persons were supplied at so much per light, which might mean 15s. or 16s. per 1000 feet. He was the originator and promoter of the Company, and canvassed the town in order to get consumers of gas interested in it as shareholders—in fact, shares were only allotted to consumers of gas—and it was in reality a Gas Consumers' Company. They had always acted on the principle of considering the interests of consumers as well as shareholders. As to whether he deserved

what the Company had done for him, he left that to the Directors and shareholders. He worked for the Company for many years almost day and night at a small salary—a salary which many persons in these days would disdain to think of, and the annuity was granted him in consequence of that. Until March, 1890, they had been able to realize not only sufficient to pay their dividend, but to put aside something every year towards accumulating a fund to equalize their dividend. This fund was quite distinct from a reserve fund, and was invested. It was a floating balance, and amounted to upwards of £16,000. So that their reserve, with that added, really made more than £30,000. Having alluded to the cost of the labour agitation, he said the wages paid by the Company had gone up 30 per cent. If it had not been for a favourable arrangement with regard to the coal contracts, which represented something like 1s. per ton less than in the previous year, or about £2500, they would have had to draw on their reserve fund to the extent of nearly £4000. As to the coal contracts, they had found it much to their interest to visit Newcastle, and make the contracts there. They had sometimes obtained the coal at 6d. and 9d. per ton less than other companies, with an extra 5 per cent. off, which meant something like £1000. Their coals were properly tested, and if they were not made to produce what was expected, their Engineer would speedily hear of it. As to Mr. Tucker, he received a gratuity when he left; and he was asked to remain with the Company even if he could not do the full work, but he declined to do so. The matter would receive the consideration of the Directors.

The motion was adopted; and the dividends recommended were declared.

The retiring Directors having been re-elected,

A special resolution sanctioning the issuing of £7500 in 750 shares of £10 each was passed.

The usual vote of thanks to the Chairman and Directors and the officials concluded the proceedings.

THE CAPE TOWN GAS-WORKS.

Our readers may remember that nearly two years ago a Company was formed under the title of the Cape Town and District Gaslight and Coke Company, Limited, to acquire the works of the Cape Town Gas Company, as well as those of the South African Gas Company at Woodstock, and carry them on as an amalgamated concern. Although having a separate title, the Company is really a branch of the Gas, Water, and General Investment Trust, Limited, whose chief office is in London. The Company's works (which are under the supervision of Mr. W. Arnott) have lately been illustrated and described in the *Cape Argus*, from which we extract the following particulars. The storeage plant at the old works consists of three holders, of 14,000, 18,000, and 44,000 cubic feet respectively—76,000 cubic feet in all; but as the daily consumption of gas in Cape Town alone is at present considerably more than 100,000 cubic feet, and on Saturdays about half as much again, it will be seen that additional room is required. Then the manufacturing plant is only equal to the production of 120,000 cubic feet of gas per diem, though, on a push, about 15,000 cubic feet more can be squeezed out. In this position of affairs, and in view of the fact that the consumption has increased 30 per cent. during the last two years, it became evident that something must be done in the way of extension. Arrangements were accordingly made for the erection of an additional holder; and this is now being put up by Messrs. Renshaw, of Kidsgrove. It will be 65 feet in diameter, in two lifts; and it will afford room for the storeage of 120,000 cubic feet of gas. When finished, it will be the largest holder in South Africa. It being, however, found impossible to wait till it is ready, the Company have laid a 9-inch trunk main, 2¼ miles long, connecting their Woodstock works with Cape Town; thus enabling them to use in the city the surplus gas made at their suburban works. Further, it is proposed next summer to entirely remodel the Cape Town works, which are rather old-fashioned; and the Company will then be able not only to reduce the cost of manufacture, but increase the make up to something like 250,000 cubic feet of gas per diem. This will adequately meet any demand that can arise for some years. The staff at Cape Town numbers 60 men; that at Woodstock (where the works are in the charge of Mr. Blake), 20 men. Since the formation of the new Company, it has been found necessary to put in 3¼ miles of new mains; making the total length of piping about 30 miles. Taking Cape Town and Woodstock together, the daily consumption of gas ranges from 150,000 to 160,000 cubic feet; but on Saturdays it rises to 200,000 cubic feet. As mention has been made of the staff, it may be added that employees at the two works, on the 7th ult., had their sports in accordance with a programme arranged by Mr. Arnott, who distributed the prizes to the successful competitors. The occasion was specially interesting from the fact that Mr. Arnott was presented by the men with a handsome diamond pin, as a token of their respect; the foreman of the works receiving a gold pin; and Mr. Blake, of Woodstock, a ring.

CAPE TOWN AND DISTRICT GAS COMPANY.

The Ordinary General Meeting of this Company was held last Friday, at the London Offices, Winchester House, E.C.—the Hon. HENRY NOEL in the chair.

The notice convening the meeting having been read,

The CHAIRMAN said this was the first time the Directors had had the pleasure of meeting the shareholders; and perhaps they would like to know something about the two properties they had acquired—viz., the gas-works at Cape Town and Woodstock. Cape Town had had gas-works for upwards of 40 years; but at Woodstock (which was a thriving suburb) the works were quite new—indeed, they had only been making gas since May, when they came into the Company's possession. It might be supposed that gas-works which had been in existence for 40 years would have been model ones; and capable of supplying not only the present but future requirements. This, however, was not the case. They had received them over in what might be termed a "beggared" state. The consequence was that all profit for a time had ceased; but they hoped soon to tell a different tale. Their Engineer reported that there was a great deficiency in the storeage accommodation; and they had therefore to build a new holder, which was now about completed. The mains too were utterly rotten, and quite insufficient for the quantity of gas required; so that they had laid down about 5000 yards, mostly of larger size. There was likewise a great deficiency in the coal storeage; and they had erected a store capable of containing about 1000 tons. The Engineer also reported that the Woodstock works were of no use to the Company as they then were. But they had since been connected to the Cape Town works by a large 9-inch main, and were now in full operation. All property, the Chairman observed, was of value only so far as it furnished an income; and the question for them was, "Can these works furnish an income, and enable us to earn a dividend?" The dividend might be earned in three ways—First by increasing the production of gas per ton of coal carbonized; second, by an increased sale of gas; and, third, by reducing the loss by leakage. If they could produce as much gas per ton as was done at home, the present consumption of coal would give an increased income of £3000 a year. This was shown by the figures in Mr. Alfred Lass's report. The quantity of gas produced per ton at the Cape Town works was 7500 cubic feet, as against 10,000 feet in London. This was owing to the wretched condition of the retorts; but, by the works they were now carrying on, they hoped to get a larger production. Then as to increasing the sale of gas, in a letter received from the Engineer (Mr. Arnott), he said: "Our demand for gas is increasing something wonderful, and at present is taxing all my energies to cope with it." He further showed that he was now sending out from 190,000 to 200,000 cubic feet a day; as compared with 120,000 to 130,000 feet this time last year. It was a great pity, however, that they had not additional carbonizing plant; everything now being worked up to its extreme limit. His (the Chairman's) observation upon this was that, if they continued to increase the sale of gas, it would give them another £3000 a year. As to the third point, the loss of gas by leakage amounted to no less than 16 per cent. of the make; and if they could reduce it to the ordinary rate in London, this would also mean a saving of £3000. These items would together make an increase in the revenue of £9000 a year; and it was to accomplish these points that the most sedulous attention of the Board was now being directed. If they could effect this, the prosperity of the Company was assured. The accounts showed they had not earned a dividend; but the "issuing" house were so confident of success, that they had made them a present of the money to pay the shareholders a 4 per cent. dividend. Having mentioned that no business could be transacted at the meeting as there was not a quorum, the Chairman concluded by moving that it should be adjourned for a week.

The motion having been seconded,

Mr. FOX suggested that the Articles of Association should be altered so that such a large quorum should not be required. The statement of the Chairman was a very melancholy one; and shareholders did not like a gratuity instead of a dividend. What struck one was, it seemed strange that they had come into such a lot of rotten property, for which they had paid more than they should have done. It was a question whether they ought not to take some steps with regard to those who had let them into this.

In the course of further discussion, one shareholder said he supposed that, before the Company was floated, those who were responsible for the promotion took some means to ascertain the value of the property, while another gentleman remarked that it seemed to him that those who were paying them the gratuity of 4 per cent. must have received a large sum of money, or they would not have made this offer.

The CHAIRMAN said he was not competent to speak on this matter, as he had nothing whatever to do with the promotion of the Company. The Secretary (Mr. J. A. Kelman) was now in America; and he imagined that the whole of the negotiations were in his hands. In answer to a further question, he stated that Mr. Lass went out to the Cape to report upon the property.

Mr. LASS remarked that he merely visited the Cape to report upon the profits for the previous three or four years. He had nothing to do with the works or with their state, nor was he concerned in the promotion of the Company. The Engineer (Mr. Stevenson) who reported on the works was present.

Mr. E. HERBERT STEVENSON remarked that, like Mr. Lass, he was not a promoter. He was retained to go to the Cape to report as to whether the works were in a state to earn the then profit. The works were in that state; but he reported distinctly that the mains were in a bad condition, or at least the portion of them which had now been enlarged or replaced. If he remembered rightly, the leakage (as mentioned in his report) was at that time from 17 to 18 per cent.; but this had now been reduced. He also stated that the Cape Town works were small for the demand; and they continued so until the Woodstock works were connected with them. Personally, he thought the Directors had acted wisely in allowing some time to elapse before they decided whether to renew the Cape Town works, or to extend those at Woodstock. As soon as the new works were constructed, and they had a proper sale of gas per ton of coal and a fair leakage, there was no question that good profits would be realized. That was the substance of the report he made to the promoters; and he supposed they considered this was sufficient, and that there was a prospect in the future of good profits. He also stated in his report that he believed a large increase would take place in the consumption of gas; and this was fully borne out by the figures the Chairman had quoted.

Mr. LASS said he should like to give some figures bearing on this matter, because they would perhaps satisfy the minds of the shareholders. In 1887, the quantity of gas sold was 25,816,000 cubic feet; and in 1891, 35,513,900 feet, which was an average increase in the sale of gas of 9·08 per cent. compound. During the past fifteen months, the income had amounted to £27,120. It seemed pretty clear that out of this they ought to have derived a certain amount of profit. He found that the expenses had reached £24,436; leaving a profit of only £2683—the expenses being something like 90 per cent. on the income. When he told the shareholders that the average outlay of the London Companies on the gross income amounted to only 69 or 70 per cent., it

would be seen at once that the expenditure to earn an income during the last fifteen months had been much larger in proportion than it ought to have been. He would give a few figures with regard to the working; and these would show why larger profits had not been made. In the first place, the quantity of gas produced per ton of coal carbonized was only 7578 cubic feet, as against the 10,300 feet which ought to have been made. Then they had sold 6328 feet per ton, which was only 83¼ per cent. of the make; 2·17 per cent. had been used on the works; and this left the unaccounted-for gas at 14·32 per cent. Now with such make, a sale, and leakage of gas as this, it stood to reason that there would be a much less profit than at a works conducted properly. The working expenses during the fifteen months had been at the rate of 64·13d. per 1000 cubic feet; while in the case of the London Companies (though perhaps it was not altogether fair to compare the figures seeing that labour was so much dearer at the Cape) they were 15·28d. These few figures spoke volumes in themselves. The works were acquired as from Oct. 1, 1890, but the present Company did not take possession until about May, 1891; so that for seven or eight months they were being carried on by the old Company in trust for the Syndicate or for the Company, he did not know which. Probably during the time that the old Company were acting as trustees on their behalf, they were not quite so careful with the expenditure as they themselves might have been. He also gave the shareholders one or two other facts which bore indirectly on the small amount of profit. The storeage of the old works consisted of three holders, capable of storing a total of 76,000 cubic feet; whereas the daily consumption of Cape Town alone was at the present time considerably more than 100,000 feet, and on Saturdays the consumption was double the quantity of gas stored in the three holders. The consequence was that, when the holders had been filled about the middle of the day, no more gas could be made until the evening. Then they had to charge the retorts again; and before the coal was half carbonized, they had to put in fresh coal, in order to keep the district supplied. Of course, while the retorts were standing idle, the men's wages and other expenses were being incurred; and this was one thing which had acted prejudicially to the making of profit during the past fifteen months. With regard to the connection between the Woodstock and the Cape Town works, the night after this was completed (a Saturday night) they had a consumption of 180,000 feet, as compared with 100,000 feet the previous Saturday. The Woodstock works had, up to that time (about six months ago), not been earning all the money they should have done; and yet they had had expenses in connection with them. The Manager proposed to utilize these works as much as possible now, and to pull down the retorts at Cape Town, and reconstruct them on the latest principle.

Mr. Fox remarked that he became a shareholder chiefly through Mr. Lass's report. It seemed that their gross profit was only £2813; while the Directors' allowances in London and Cape Town amounted to £1736, and the deficit on profit and loss account was £1059. He should submit, at the proper time and in the proper place, that their expenses were out of all proportion to their profits; and he should have to consult some of his fellow shareholders on these points.

The motion adjourning the meeting for a week was then agreed to; and the proceedings terminated.

A Petroleum Oil Trust.—The Petroleum Oil Trust, Limited, has been formed with a share capital of £430,000, to acquire petroleum oil deposits in the Peninsula of Gaspé, in the Province of Quebec, British North America. The property vested in the Company consists of 40,137 acres of freehold land, and perpetual mining rights over 10,220 acres. The purchase price is £315,000. The Company wish to develop the property on an extensive scale.

New York Water Supply.—The water famine with which the city of New York was recently threatened has caused the authorities to take steps which will render any similar occurrence impossible in the future. Tenders were solicited for work on the new Croton dam, plans for which had been adopted by the Aqueduct Commissioners; and it is expected that work on this great dam will be begun in the present month—the whole work to be finished, according to contract, by Jan. 1, 1899. There are to be several dams (the smaller ones having a combined capacity of 30,000 million gallons), and the large Croton dam, which is to equal in capacity all the others combined; so that at the beginning of the next century the city will be able to have stored a supply of 60 billion gallons of water, which at the present rate of consumption would last more than a year. The work will involve a great many difficulties. Since the Croton River flows through the side of the dam, it will be necessary to divert its waters into other channels. The maximum flow of the river is 12,000 million gallons per day, and a channel must be provided for this enormous flow. The cost of the new dam is estimated at about £1,400,000.

Chambers of Commerce and Labour Disputes.—At the congress of representatives of Chambers of Commerce last week, Mr. S. B. Boulton (Chairman of the London Conciliation Board) moved—"That the frequent recurrence of labour disputes has caused and is causing great damage to the commercial and manufacturing interests of the Empire; that it is extremely desirable, in the best interests both of employers and employed, that the readjustment of the rates and conditions of labour, which from time to time are inevitable, should be brought about without the wasteful and calamitous results proceeding from strikes and lock-outs; and this Congress strongly recommends the formation of properly constituted boards of labour conciliation and arbitration in all important centres of industry and commerce throughout the Empire." Mr. Dibbs (Premier of New South Wales) bore testimony to the excellent effects these boards had had in the colony from which he came. Lord Brassey, in supporting the resolution, said he had been the umpire in many trade disputes, and his experience had led him to the conclusion that it was far better to refer such matters to a board of arbitration and conciliation than submit them to an umpire selected from outside, with no technical knowledge of the questions in dispute. The motion was carried unanimously.

THE METROPOLITAN WATER SUPPLY COMMISSION.

Monday, June 27.

(*Lord* Balfour of Burleigh, *Chairman*; *Sir* G. B. Bruce, *Sir* A. Geikie, F.R.S., *Professor* Dewar, F.R.S., *Mr.* G. H. Hili, M.Inst.C.E., *Mr.* J. Mansergh, M.Inst.C.E., *and Dr.* W. Ogle, *Commissioners.*)

To-day further evidence was given on behalf of the London County Council.

Mr. *W. H. Dickinson*, Deputy-Chairman of the Council, in answer to the Chairman, stated that he appeared before the Commissioners to tell them officially of the resolutions which had been passed with reference to the water supply of London; and he handed in a statement containing a narrative of the proceedings which led up to the appointment of the Commission. Commenting upon this statement, he said that, in the early days of the existence of the Council, they appointed a Water Committee to consider the whole question of the water supply of London. After full consideration, however, they came to the conclusion that they had not sufficient opportunities of obtaining evidence; and therefore they asked the Government to institute an inquiry by Royal Commission. This request not being acceded to at first, the Committee resolved in November, 1891, to obtain an exhaustive report from their Engineer and two other well-known Engineers, so that they might lay the whole matter fairly before the Council. Shortly afterwards Mr. Ritchie announced that he would advise Her Majesty to appoint a Commission such as was asked for by the Council; and since that time the Water Committee of the Council had confined their action to making the necessary arrangements for having all the informal tion at their disposal placed before the Commission. After considering the reports laid before them, the Council decided not to take up any definite position, either favourable or antagonistic to the present methods of supply. In regard to these reports, the Council did not make themselves responsible for the statements or arguments which were contained therein; but the gentlemen who had drawn them up put them forward as from themselves. It had been thought premature and undesirable for the Council to attempt in any way to prejudge the questions into which the Commission were inquiring; but, the latter having expressed a desire to be furnished with some indication of their views on the inquiry, a memorandum was prepared and discussed by the Water Committee. As the result, the following resolutions were adopted: "(1) That, in making any estimates having reference to the future water supply of London, such estimates should be based upon a period of 50 years from the present time; (2) that, in dealing with the question of a source or sources of water which shall meet the requirements of London and its neighbourhood for 50 years, provision should be made for supplying a population of at least 12,500,000; (3) that, in calculating the quantity of water required per head per day, the amount at present supplied by the Companies should be increased by at least 10 per cent., and in no case should it be less than 35 gallons." He would agree generally with the fact that the longer the period in advance to which they had to look, the greater would be the danger of making a fallacious calculation; and this was one reason why the Committee had taken the period of 50 years in preference to one of 60 years or longer. They had studied, in connection with this subject, in order to get some indication of the lines on which they ought to proceed, the water supplies of Birmingham, Glasgow, Manchester, or other large towns. Generally, he would agree that possibly a municipal authority having the control of the water supply would have greater power conferred upon them for the purpose of checking waste than would be placed in the hands of a trading company; but, on the other hand, there would be a larger demand made on them for the supply of public fountains and similar purposes. He knew that in Liverpool they had to a great extent been able to curb waste. Dealing next with the increased population to be provided for, he said that a quantity of 12,500,000 gallons would have to be allowed for the supply of Greater London. The question of quality had been very much before the Committee; but they came to the conclusion that they ought not to make any reference to it in their statement to the Commission, because they had such antagonistic views submitted to them that they felt it was impossible for them to come to any definite conclusion at present on the matter. They thought it should be left to be investigated by the Commission; but their own view was that a considerable amount of pollution passed into the rivers. The evidence they had collected in regard to the pollution of rivers would be laid before the Commission. At a later stage of the proceedings, witness stated that the Council had agreed to pay half the cost of an inquiry made by the Royal Society into the bacteriological condition of the water. He understood that a letter had reached the Council to the effect that the Society would lay before them an ultimate definite report in October; the Council having already received a preliminary one, which had been placed in the hands of the Commission.

Sir *T. Farrer* was the next witness. He said he had not considered it to be necessary to make any detailed statement other than those already before the Commission; but he thought it only respectful, having been Chairman of the Water Committee, to present himself in case it should be desired to ask any questions of him. He believed that during the recent inquiries one fact had come out which was not patent to them before, and that was the enormous demand to be made by the surrounding counties for the water which had hitherto formed part of the supply of London. If it should happen that London had to supply the whole of the surrounding districts, the demand of these populations would have to be taken into account, as well as those of London proper.

The Chairman: When you say London proper, do you mean the present district of the London Water Supply; or what we call the County Council area—Inner London—or the Metropolitan Police District?

Witness: The smaller area is that of the London County Council; and within that only have they at present jurisdiction. There is next the larger area of the Metropolitan Water Companies.

You cannot compare very well the area of the Water Companies

with the Metropolitan Police district, can you?—No; you cannot say one is larger than the other.

As to the Metropolitan Police district and the London Water Companies' districts, at some points the area of the one is greater than that of the other?—That is so.

What is London proper?—It is that which is within the area of the County Council in the first instance. If the Council took over the sources of the Water Companies, those of the Companies in the neighbourhood would have to be provided for; but my observation went a little further than that. What I meant to say was that, without having regard to any present boundaries at all, the populations of the counties surrounding London are growing, and they are making a larger demand every day upon the water which is obtained within their districts. Consequently, if the County Council or the Companies are to take very large additional supplies of water from Hertfordshire, Buckinghamshire, or Surrey, there will be a resistance to them in the first instance; but if they get the supply, there will be a demand upon them from those counties, and that demand has to be taken into consideration in what we are to do in the future. I wish to confirm, from my own personal knowledge, the account which the Thames Conservancy have given of the origin of their jurisdiction over the water of the Thames. It is true that the Upper Thames Navigation Commissioners were in a state of absolute insolvency; and that when Mr. Milner Gibson was President of the Board of Trade, there was extreme difficulty in ascertaining what to do with that Upper Navigation. The Thames Conservancy—I would almost say reluctantly, but at any rate with no ambition on their part—at the desire of the Government, took in hand the Upper Thames; and they then, being a wealthy body, and having at their disposal the funds arising from the Lower Thames Navigation, made this help the Upper Thames. The latter has always been "out at elbows;" and it has been with me rather a matter of doubt whether the very large contribution which the Water Companies pay the Thames Conservators can be properly attributed or appropriated to the water supply of London, and whether it has not gone a good deal towards maintaining the Upper Thames Navigation.

A good deal of the negotiations which resulted in the present arrangements took place while you were at the Board of Trade?—Yes; I was permanent Secretary to the Board, and so I have known the whole of the negotiations from the beginning.

Dr. *G. Turner*, M.B., was then called. In answer to the CHAIRMAN, he stated that he was Medical Officer of Health for the combined sanitary districts of Herts and Essex. At the desire of the County Council, he had examined the River Lea and its tributaries, and had made a report on the state of those rivers. The area comprised within the valley of the Lea was not easily defined. But it extended over about 495 square miles; and the population in 1891 might be between 143,000 and 146,000. An inspection of the rivers, made for the purposes of the report, showed that about 95,000 persons living in towns and villages discharged sewage effluents, after more or less purification, into the river; and of these the effluents from 85,000 might be regarded as efficiently purified. A pretence of purification was made in regard to the sewage of three villages with an aggregate population of 5500; while five others, with a total of 7000 inhabitants, ran unpurified sewage into the streams. The remaining 50,000 people, living within the area in villages and scattered farms or cottages, would not generally be supposed to pollute the river; their places of residence being too far away from the banks. But the possibility of at least occasional pollution from farms and houses at considerable distances from the river was much greater than he had supposed until he paid particular attention to the question; and then it became evident to him that during the rainy weather the drainage from many of the cottages could be traced, greatly diluted, through ditches till it reached the river. In round numbers, sewage, sewage effluent, or slop water from 100,000 persons reached the Lea and its tributaries above the intakes of the Water Companies. The only manufacturing process which required consideration as fouling the river was that of malting; and he had found that no less than 8,896,250 gallons of malting water were turned into the streams. Touching next on the question of the safety of the consumer in drinking water from the Lea, witness said it depended on three things: (1) The quantity of clean spring water which reached the streams, and which served to dilute and oxidize the organic matters contained in the sewage; the quantity of water decreasing from year to year. (2) The length of flow, between the point of pollution and the intake, in which oxidation may take place. (3) The filtration which the water undergoes at the hands of the Companies. From reports received from millers living on the banks of the streams, he had come to the conclusion that there was 60 per cent. less water in the Lea, Beane, Mimram, Kib, and Ash, and none, or practically none, in the Stoat. Dealing then with the subject of filtration, witness said that the filtration was probably as efficient as it could be made at present; and the Companies were entitled to credit for the care they seemed to have exercised in the matter, because he had evidence to show that the water of the Lea and its tributaries above the intakes had produced typhoid fever when it was consumed unfiltered. These cases had occurred at Hertford in 1883, 1884, and 1886; and at Stanstead this year. He was of opinion that the possibility of improving the river by intercepting drains was much over-estimated. It had been asserted that no effluent from sewage went into the River Lea above Hertford which was not very carefully passed through land; and it had also been stated that the only pollution of any serious moment on the River Lea took place at Hertford. Both of these statements were, in his opinion, correct. As for Hertford, anyone examining the river at the outfall, and knowing that it received a sewage effluent, would naturally conclude that the appearances there observable were caused by that effluent; and in April, 1882, when he was directed to make an examination of the sewage works, and to analyze the effluent, and found only 29 grains of chlorine, 0·16 grain of saline matter, and 0·05 grain of albuminoid ammonia per gallon in the effluent, he was at a loss to understand the result, and believed that, in some way or other, an effluent of more than usual purity had been prepared for his visit. But since then numerous analyses had been made by various men with practically the same result. A larger and better acquaintance with the state of affairs at the outfall had convinced him that the treatment at Hertford did not give drinking water, but water which was quite harmless to a navigable river; and that the appearances noted—viz., dark colour, &c.—were not caused by the effluent, but by the nature of the soil over which it flowed, and the mismanagement of the Lea at that point. With regard to the supposition that no pollution took place above the intake of the New River Company, he had recently visited Wheathampstead (a village of 2000 persons on the Lea), and had found in operation a kind of precipitation process so little efficacious that it did not remove the colour of blood from the sewage. After running through a small tank, the effluent was filtered through a few barrowfuls of gravel and some straw, and was discharged by a pipe into the river, where its course along the bank could be seen for some distance by the colour of the blood. He had tables to which reference could be made for a complete list of pollutions; but he thought enough had been said to show that untreated sewage in large quantities reached the rivers above the intakes. It might be possible to improve the River Lea in many respects, especially if the riparian authorities were not excluded from any jurisdiction in the matter. But no improvement in the case of villages and towns, the sewage of which it was possible to collect and treat, would render the water of the Lea fit to drink while the land was used for agriculture, and the river for transport, especially the transport of manure. Everyone who had paid attention to the question was of opinion that the manure was a serious nuisance. It was not at all like ordinary stable manure, but indescribably filthy, and had every opportunity of being specifically contaminated. Much of it was deposited on the banks just above the intake of the East London Water Company. The quantity was about 50,000 tons per annum. As the whole of the excrement of the total population above the intake of that Company did not amount to 5740 tons in a year, it bore a very insignificant proportion to the manure; and it seemed hardly worth the time and trouble to deal with one-ninth of the polluting matter—the sewage—to the neglect of the manure. It was not known how far filtration was a protection against typhoid fever; but if it should be proved that careful filtration did afford protection, this would not serve as an answer to the question: "Will it act equally well with regard to cholera?" He considered it to be a mistake to use the River Lea for a public water supply, as it was impossible to stop the navigation of the river and the cultivation of the land; and so long as these continued, the river must be polluted.

Professor DEWAR: Have you ever drawn the attention of the Sanitary Authorities to the disgraceful state of affairs that you have spoken of with reference to Wheathampstead?

Witness: Yes.

Did they take any action on your report?—They did not.

You complained in 1882, and since that year there has been no diminution in the amount of pollution?—No, not a bit.

Can you give me the name of any other place with reference to which you complained?—Walkern. I know I complained in the year 1886 or 1887. It would have been altered a long time ago, but objections were raised that the effluent might get into the river; whereas it was running into the river every day when I complained. I must tell you that we have no jurisdiction over the river.

You have only jurisdiction over the sanitary condition of the district?—That is all; we cannot prosecute for pollution of the river. The only power I have is to recommend them to take certain steps; and in my annual reports, I mention the fact to the Local Government Board. I may say that I have done that in some cases from year to year, until at last I have stated that the Local Board are as well aware of the facts as I am; and I shall make no more reference to it.

Taking the land of your district as a whole, is it admirably suited for sewage farms?—Not in the lower part.

Your objection being to the low-lying nature of the land?—Yes.

But the land *qua* land is admirably adapted for sewage farms?—In the higher parts; in the lower I should not like to speak so confidently.

Have you ever considered, in relation to this district, what has been the most satisfactory mode of treating sewage?—I believe that a farm is the best.

You have said that nothing will render the Lea fit to drink while the land is used for agriculture, and the river for transport, especially the transport of manure?—Yes; I maintain that. I object entirely to vessels passing backwards and forwards in front of the intake, and sending out bilge water into the intake.

So that it is the danger from life on the river that you chiefly object to?—Each objection has its place. That is one of them.

But that would be the most serious one?—That, in my opinion, is a very serious one.

Questioned on the subject of micro-organisms, witness said he did not believe the simple counting of them was of any use at all. He had taken water from the sewage works at Hertford, and had found therein, as it came straight from the filters, fewer micro-organisms than there were in the water of the New River at the same place.

Sir A. GEIKIE: Regarding the diminution of water in the stream, I understand your results have been ascertained by you partly from your own observation, and partly from the statements made by millers. May I ask if you have thought out what is the cause of this diminution? Can you attribute it to anything?

Witness: I attribute it partly to less water in the ground, due to pumping, and to the greater increase of agricultural drainage.

The Commission then adjourned till the next day.

Water-Works for Norton (Malton).—A short time ago, Major-General Crozier held an inquiry at Norton on behalf of the Local Government Board, into an application by the Local Board for permission to borrow the sum of £3500 for the purposes of providing a new water supply for the town. It was explained that the proposal is to sink a well, and erect a pumping-station and reservoir at Howe Hill, where a copious and good drinking water had been found. The object of the Board in making the application was to have "a constant supply of their own, better in quantity and quality, and at a cheaper rate than they were now being charged by the Malton Board for a partial supply." The Inspector said there was evidently no practical opposition to what seemed to be a good scheme.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The result of the ballot among the members of the North British Association of Gas Managers as to where this summer's gathering is to take place, has determined that it is to be at Stirling. At last year's meeting in Edinburgh, it was agreed that the meeting this year should be in Dundee; but in view of the proceedings at the Wallace Monument, on the Abbey Craig, near Stirling, in connection with the unveiling of the Murdoch bust, the Committee thought it desirable that the place of meeting should be Stirling. The members were consulted on the subject; and they have approved of Stirling. Mr. M'Crae, of Dundee, was very anxious to have the Association in his city this year, and he may not therefore approve of the decision; but I think it is a most sensible one. There will be a considerable ceremony, with, probably, civic dignitaries called in to assist. The Custodians of the Monument will, of course, be present; and these are all gentlemen located in the neighbourhood of Stirling. It would have been unseemly to have had the ceremony dominated by the Dundee Corporation in any form; the Stirling Corporation were bound to take the leading place. It would be unwise to have saddled the funds of the Association with the cost of two Corporations; and it would also have been unwise, considering that many members of the Association are not overpaid, to have put them to the cost of the long railway journey from Dundee to Stirling. It is true that Stirling had the honour of the Association in its midst so recently as 1887; but the early return to that town is due to very exceptional circumstances, and it would be a graceful act on the part of Dundee gentlemen if they were to recognize that, and assist in making the meeting a success. In consideration of such favour, the Association, having made a departure from custom, might go a step further and make another, by resolving that instead of holding next year's meeting in Glasgow, it should be held in Dundee. That should please all parties.

The Association is to meet at Stirling on Thursday and Friday, the 28th and 29th of July. The arrangements for the meeting have not yet been completed, because the President, Mr. A. MacPherson, of Kirkcaldy, has got married and gone away on his honeymoon. This is a piece of information which, I am sure, Mr. MacPherson's many friends who read the JOURNAL will be delighted to have. A newly-married President will be a sort of sensation at the meeting; and the congratulations he will receive at the hands of his fellow-members will be both numerous and hearty. The arrangements for this month's meeting will be easily made in time; and when the day arrives, there will be no difficulty on that head. What I am concerned about is—begging Mr. MacPherson's pardon—the Presidential Address. I have never seen a President in such a trying situation; and I am afraid that, unless Mr. MacPherson took the precaution to have his address ready before his marriage, he may be disposed to introduce other subjects into it than those we are usually treated to. This is by the way, however. I know Mr. MacPherson's versatility; and have no fear that everything will be done by him which can be to make a successful meeting. The principal event will be the unveiling of the Murdoch bust; and in that connection, the Association are to be congratulated in having a President this year who will be able to maintain its dignity in any company in point of eloquence and readiness of expression, as well as in those other qualities which make Mr. MacPherson always an agreeable and sociable companion.

The Edinburgh and Leith Gas Commissioners, at their monthly meeting on Monday, transacted only one item of business which is of general importance, although they had several others before them which were not without importance to themselves. This had reference to their coal contracts. They have been in the habit of contracting for coal for the period that corresponds with their financial year, which begins the 16th of May. This was found last year to be an awkward arrangement, because, when they had fixed the price of coal, they did not know how the year which had just expired was to turn out; and it was not till autumn that they could settle the price of gas for the year. They had therefore either to fix the price of gas, say in September, as from the 16th of May previous, or to have it fixed at the April meeting, as at the 16th of May ensuing—in the dark as to what their prospects were. They did the former last year; and some one in the community was cute enough to find out that the Commissioners had not power under their Act of Parliament to post-date the period of an increase in the price of gas—that was, they could not supply gas from May to September to a consumer who took it on the assumption that the price was 3s. 9d. per 1000 cubic feet, and then tell him that he must pay 4s. 6d. as from the 16th of May. In the case of a reduction under similar circumstances, I suppose no cavil would have been made; but it is different when a rise takes place. To avoid this difficulty, the Commissioners have resolved in future to make their coal contracts and the fixing of the price of gas coincide. They cannot change their financial year, which is fixed by Act of Parliament; but they can do as they please in the matter of coal contracts. Under their new policy, accordingly, they are to wait till the result of the previous year's working is known, and contract for a year's coal and fix the price of gas at the same time. The arrangement is a very suitable one in more respects than one; and perhaps chiefly because it will bring them into the coal market at a time when there will be few others competing with them, and after the first blush of the winter demand for coal is over. The disadvantage it will have is that, when they come into the market, they may find that certain varieties of coal which they would like to get have been all taken up. They this season, in entering upon their new policy, have only contracted for coal to keep them going till the autumn, when they will solicit offers for a twelvemonth's supply. When they were last in the coal market, they contracted for 117,600 tons of coal for the Edinburgh works, at an average price of 20s. 8¾d. per ton, and for 40,700 tons for the Leith works, at an average price of 20s. 9¾d. per ton. There was a diminished output of gas during last year; and consequently Mr. Kinloch Anderson, the Convener of the Works Committee, was able to tell them that they would require no coal till the autumn for the Leith works, and only 5500 tons of the third and fourth classes for the Edinburgh works. Mr. Kinloch Anderson made the important announcement that, after going carefully into the sperm value of the coals which were offered, they had selected, as an experiment, several new varieties of coal; and that, if these came up to the analysis of Mr. Mitchell, they would be able to keep up the illuminating power to what they had fixed—about 27-candle power. The importance of this statement is that it puts to an end the accusation of Mr. Wells, made a few months ago, that the same people always get the contracts. Of course, there was no foundation for the charge, looked at in the light of an accusation; but this shows that the Commissioners are willing to buy coal wherever they find it to be suitable, and not on any account to favour anyone. The Commissioners adopted the recommendation of the Committee, and agreed to the contracts for the 5500 tons of coal required. There is this gratifying feature about the new contracts, that a considerable reduction has been effected in the price, which is encouraging in view of the larger contracts that are to be entered upon in a month or two. The coal they have secured is at an average price of 12s. 2d. per ton, a decrease of 2s. 3d. per ton; and should they get their full year's contracts at the same rates, they should have easier times in the year which has now been entered upon.

On the above-named occasion, the Commissioners had before them a proposal by Mr. Pollard, that they should consider whether they might not apply their sinking fund at once in the redemption of their own annuities, instead of waiting till November, 1908. By the Commissioners' Act of 1888, they are not entitled to compulsorily acquire annuities for 20 years; and then they may acquire them at 28½ years' purchase. They are obliged to set apart a certain sum every year—15s. per cent. on the capital value of the annuities—for their redemption, which amounts to £7267. That sum at the end of 20 years, even with compound interest added, could not amount to more than £200,000; and as the capitalized value of the annuities is £969,000, the redemption of them would be slow work. The Commissioners have difficulty in the investment of their sinking and reserve funds, only getting 3½ per cent. per annum for them; and it is considered that they might more profitably employ the sinking fund in the purchase of annuities as they come into the market, which they continually do. I understand they can be bought for about 3 per cent.; and if that could be done, it would certainly be a relief to the Commissioners, in getting rid of the yearly payment of annuities, which would be well earned.

The Hawick Gas Company, which is the leading undertaking in the South of Scotland, has had a very successful year, and has again been able to pay its customary dividend of 10 per cent. Its position was very eloquently described by the Chairman, Mr. T. Laidlaw, yesterday. The profits for the year, he said, were quite beyond their expectations, when they considered all the circumstances. They had reduced the second reserve fund, chiefly by payments for extensions of works, from £4486 in 1887 to £18. They had, however, still their first reserve fund, amounting to £3117; and they desired to keep it intact. The large stock of coal they started with last year enabled them to sell gas of 28-candle power at the low figure of 3s. 4d. per 1000 cubic feet. They had a large stock of coal on hand, and had been fortunate in their purchases; but owing to the fall in the price of residuals and the exhaustion of their second reserve fund, they required to raise the price of gas from 3s. 4d. to 3s. 11½d. per 1000 cubic feet. During the year, the Town Council made an experiment with the electric light in the town, at a cost which he had not been able to discover. Their Directors had a report from Messrs. Siemens Bros. that it would cost £100,000 to light the town with electricity. The experiment had been pronounced a failure; and it did not affect them, for the consumption of gas had increased by 2,432,000 cubic feet. The report of the Directors was adopted.

The Finance Committee of the Dundee Water Commission have fixed their estimates for the current year. The revenue is expected to be £46,564, which includes a surplus from last year of £1882. The expenditure is estimated to be £46,500, showing a surplus of £64. The Committee consider the position to be highly satisfactory; and recommend the Commission to approve of it. They also recommend that the water-rates shall remain the same as last year.

Natural Gas in Pittsburgh.—The discovery of a new natural gas-field of about 80 square miles within 15 miles of Pittsburgh is practically confirmed. Its importance is also enhanced by the prediction that an oil-field will be developed to the south-west.

Norwich Water-Works Company.—The report for the six months ending March 25 last which was submitted at the recent half-yearly meeting of this Company stated that, after paying working expenses, debenture interest, and dividend on the preference shares, there remained (including the balance from the previous half year) a sufficient sum to pay a dividend on the ordinary shares at the rate of 6 per cent. per annum and leave £646 to be carried forward. The works of the Company are in good order; and the business is progressing in a satisfactory manner.

The Water Orders of the Present Session.—The two Orders contained in the Confirmation Bill included in the list of those which have just received the Royal Assent relate to Ross and Sevenoaks. The Order in regard to the first-named place is to authorize the maintenance and continuance of water-works and the supply of water in parts of the parishes of Ross and Bridstow, in the county of Hereford, with power to the Local Authority to purchase at the expiration of ten years. The Sevenoaks Order authorizes the raising of additional capital, and modifies the basis of the Company's charges.

The Pamplona Water-Works Company, Limited.—Under the failure of this Company, the usual summary has been issued by the Official Receiver. The Company was incorporated in July, 1890, and was formed to acquire a concession for the supply of water to the town of Pamplona, Spain, and to construct and equip the works in connection therewith. The nominal capital was £141,000; and debentures and shares to the amount of £26,500 are stated to have been issued to the promoter, the whole of which are held by him or his nominees. The liabilities amount to £24,957, of which a sum of £22,827 seems to be due in respect of debenture bonds and interest; and there appear to be no available assets.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *July* 2.

Sulphate of Ammonia.—There is no change whatever in this market, neither in the quotations, nor in the position. The market remains firm, in spite of its detractors; and as there is now considerable inquiry for summer and autumn delivery, it would be surprising if prices did not harden. Nitrate is still inclined to improve; and 8s. 4½d. is now quoted for good quality.

LONDON, *July* 2.

Tar Products.—There is no material change in the position of this market. A more hopeful view of the future is taken; and, as the accumulated stocks, which depressed makers in the spring, are now disappearing, it is more than likely that we shall see more remunerative prices. It is not expected, however, that there will be a return, for a very long time to come, of the extremely high prices which prevailed in benzol twelve or eighteen months ago. Notwithstanding the hot weather, carbolic acid and its products are still sold at low prices. There is little moving in anthracene; and makers still offer lower prices than are quoted below. Tar distillers have lost very heavily on their contracts during the past six months; and even those who obtain tar at the existing low prices, will have to be content with an extremely small profit if the present value of products continues. Current prices are: Tar, 8s. 6d. to 11s. Pitch, 28s. Benzol, 90's, 1s. 8d.; 50's, 1s. 4½d. Toluol, 1s. 2½d. Solvent naphtha, 1s. 3d. Crude benzol naphtha, 30 per cent., 8d. Creosote, 1d. Naphthalene salts, 20s.; pressed, 45s. Carbolic acid, crude 60's, 1s. 1d.; 70's, 1s. 4d.; crystals, 5d. Cresol, 8d. Anthracene, 30 per cent., "A" quality, 10d.; "B" quality, 7d.

Sulphate of Ammonia.—Producers are generally asking more money for sulphate; while buyers have sprung from the low level they had reached, although not yet prepared to pay the prices quoted by makers. Stocks are largely reduced; and, as there is a good inquiry, it is hoped that prices will improve. Sales are reported at £9 15s. to £10, less 3½ per cent. The last figure, however, is only obtainable where the article is in an exceptionally good position. Gas liquor (10-oz.) is quoted at 5s. 6d. to 6s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—Business is moving on only quietly, as far as all descriptions of round coal are concerned; but the restriction of the output—four to five days per week now representing about the average work of the collieries—is preventing any very large accumulation of stock, and at the same time checking any very material giving way in prices. The best qualities of round coal remain fairly steady; and it is exceptional where there has been any quoted giving way upon list rates. Common round coals are, however, more or less, a drug upon the market, and there is a decided weakness in prices; surplus quantities being pushed for sale at considerably under nominal list rates. Common steam coal is being offered at as low as 8s. 6d. to 8s. 9d. per ton, delivered at the ports on the Mersey; although for some of the better qualities, quotations remain firm at 6d. above these figures. At the pit mouth, common steam coals for inland requirements remain at about 7s. 6d. to 8s. per ton. One or two moderate contracts for locomotive fuel have been placed during the last few days at prices about 3d. to 6d. under those obtained last year, which is a substantial improvement upon the figures at which several contracts were a short time back placed. With regard to gas coal contracts, these are being settled only very slowly—gas companies and corporations holding back from closing with a view of obtaining some concessions upon the prices sent in with the tenders. So far as can be ascertained, the average concessions upon last year's prices in Lancashire gas coal contracts have not exceeded about 3d. per ton, although here and there 6d. per ton has been obtained; and the average quoted pit price for good Lancashire screened gas coal would seem to be about 10s. per ton. Yorkshire colliery proprietors, however, are now competing very keenly in this district for any business to be secured in gas coal; and notwithstanding the very strong tone which was manifested at the recent Sheffield meeting of Yorkshire and Lancashire coal owners, that the former would not give way in their price, I hear of tenders now being sent in for supplies to gas companies in the district at 9d. to 1s. per ton below last year's price—in some instances, representing not more than 8s. per ton, at the pit mouth, for good qualities of screened Yorkshire gas coal. How far this action on the part of Yorkshire colliery owners will affect quotations for Lancashire gas coal, remains to be seen; but it cannot fail to have a weakening tendency, and, judging from the quantities of gas coal now being sent over the rails from Yorkshire into this district, it would certainly seem that Yorkshire colliery proprietors have already succeeded in securing a very considerable amount of business. There is a continued brisk demand, with prices firm, for round coals; and the restriction of the output has necessarily tended to curtail the supplies of slack offering upon the market. I hear of contracts for large quantities having lately been placed at the full prices obtained last year; whilst here and there colliery proprietors have advanced their rates 3d. per ton upon recent quotations. At the pit mouth, common qualities of slack are not now quoted under 3s. 6d. to 4s. per ton; medium sorts average 4s. 6d., with the best qualities fetching 5s. to 5s. 6d.; and ordinary descriptions of burgy average about 6s. 6d. per ton.

Northern Coal Trade.—With something near a full production, the course of prices in the coal trade of the North has been downward on the whole. Perhaps this has been most marked in steam and bunker coals. Best Northumbrian steam coals are now being freely sold at 10s. per ton f.o.b.; and in a few instances 9s. 9d. has been quoted, producers being now desirous of booking orders forward as much as possible. Small steam coals are plentiful, and are quoted about 4s. 3d. to 4s. 6d. per ton. In the gas coal trade, there are now full supplies and prices are easy. About 8s. 3d. to 8s. 6d. is now the current price for best Durham gas coals; and some large contracts have been booked at prices near these. One or two collieries having large contracts ask higher prices; but there are others that quote lower. For manufacturing coals, there is a better demand, but it is well met; and though there is a large shipment of smithy coals, prices are barely maintained. Household coals are very dull, with a small sale just now. For blast furnace coke, there is not yet a full demand; and as the output is now large, prices are weaker—best Durham qualities ranging from 16s. 6d. to 17s. per ton. There is no alteration in the price of gas coke.

Scotch Coal Trade.—There was last week a slackening off in the pressure for coal shipment, and supplies were in excess of the demand. The General Election is on, and the holidays are at hand; so that supplies are not likely to be so large in the next few weeks. The former is not expected to last long; and the latter is a fixed quantity which the masters can always calculate upon; and so they are not troubling themselves with a request which has been made in the west for a return of the 6d. per ton in wages which was recently taken off. The men are not likely to get the increase, because there is at present very little forward contracting, and no appearance of much arising. The Baltic and Continental demand has now set in; and as its magnitude will depend on the quantity of coal which can be procured by foreign countries at home, opinion is divided as to how much may be expected. For home consumption, public works are ordering sparingly, in view of the holidays coming on. Winter orders, too, are not being given very freely; there being a general expectation of a fall in prices. The prices quoted are: Main, 7s. 9d.; ell, 8s. 6d.; splint, 8s. 3d. to 8s. 6d.; and steam, 10s. to 10s. 3d. per ton. The shipments for the week were 148,107 tons—an increase over the corresponding week of last year of 11,378 tons; but a decrease of 19,611 tons as compared with the previous six days. For the year to date, the total imports have been 3,511,372 tons—an advance over last year of 550,347 tons.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 26.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	13 Apr.	10½	Alliance & Dublin 10 p. c.	10	16½—17½	..	6 0 0
100,000	10	,,	7½	Do. 7 p. c	10	11—12	..	6 5 0
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	103–105*	+½	4 15 3
100,000	20	27 May	8	Bahia, Limited	20	10—12	..	13 6 8
200,000	5	12 May	7½	Bombay, Limited	5	6—6⅝	−⅛	5 15 9
40,000	5	,,	7½	Do. New	4	4⅜—5	..	6 0 0
380,000	Stck.	26 Feb.	12½	Brentford Consolidated	100	212—217	..	5 12 11
150,000	,,	,,	9½	Do. New	100	164—168	..	5 10 1
220,000	20	11 Mar.	11½	Brighton & Hove Original	20	40—42	..	5 9 6
888,500	Stck.	11 Mar.	5	Bristol	100	95—100	..	5 0 0
320,000	20	13 Apr.	11½	British	20	41—43	..	5 4 8
50,000	10	26 Feb.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	,,	8½	Do. 7 p. c.	10	15—16	..	5 6 3
328,750	10	—	—	Buenos Ayres (New) Limited	10	6⅞—7⅛	..	—
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	92—95*	+1	6 6 4
150,000	20	26 Feb.	8	Cagliari, Limited	20	25—27	..	5 18 6
550,000	Stck.	13 Apr.	13	Commercial, Old Stock	100	229—234	..	5 11 1
165,000	,,	,,	10	Do. New do.	100	180—185	..	5 8 1
130,000	,,	15 June	4½	Do. 4½ p. c. Deb. do.	100	118—121	+1	3 14 4
800,000	Stck.	15 June	13	Continental Union, Limited	100	218—223	..	5 16 7
200,000	,,	,,	10	Do. 7 p. c. Pref	100	185—195	..	5 2 7
75,000	Stck.	30 Mar.	10	Crystal Palace District	100	185—195	..	5 2 7
486,090	10	29 Jan.	10	European, Limited	10	19—20	..	5 0 0
354,060	10	,,	10	Do. Partly paid	7½	14—15	..	5 0 0
5,470,820	Stck.	12 Feb.	12	Gaslight & Coke, A, Ordinary	100	208—213	+1	5 12 7
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	94—98	..	4 1 7
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	250—255	..	3 18 5
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	118—123	..	4 1 3
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	169—174	..	4 6 2
1,300,000	,,	,,	7	Do. H, 7 p. c. max	100	154—158	..	4 8 7
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	250—254	+2½	3 18 9
476,000	,,	,,	—	Do. K, 6 p. c. Prf.	100	148—153	..	3 18 5
1,061,150	,,	15 June	4	Do. 4 p. c. Deb. Stk.	100	114—116	..	3 9 0
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	118—121	..	3 14 4
908,000	,,	,,	6	Do. 6 p. c. do	100	163—166	..	3 12 3
3,800,000	Stck.	12 May	12	Imperial Continental	100	214—218	+4	5 10 1
75,000	5	15 June	6	Malta & Mediterranean, Ltd.	5	4—4½	..	6 13 4
560,000	100	1 Apr.	5	Met. of Melbourne, 5 p. c. Deb.	100	108—110	..	4 10 11
541,920	20	15 June	5	Monte Video, Limited	20	14—15	..	6 13 4
150,000	5	27 May	10	Oriental, Limited	5	7⅞—8¼	..	6 1 2
60,000	5	30 Mar.	7	Ottoman, Limited	5	4—5	..	7 0 0
166,870	10	26 Feb.	2	Pará Limited	10	2—3	..	—
420,000	100	3 May	6	People's Gas of Chicago—1st Mtg. Bds.	100	105—110	..	5 9 1
500,000	100	1 June	6	2nd Do.	100	100–103	..	5 16 7
150,000	10	15 Oct.	10	San Paulo, Limited	10	8—9	..	—
500,000	Stck.	26 Feb.	15½	South Metropolitan, A Stock	100	265—270	..	5 14 10
1,350,000	,,	,,	12	Do. B do.	100	214—218	..	5 10 1
200,000	,,	,,	13	Do. C do.	100	230—240	..	5 8 4
725,000	,,	30 Dec.	5	Do. 5 p. c. Deb. Stk.	100	142—146	..	3 8 6
60,000	Stck.	11 Mar.	11½	Tottenham & Edm'nton, "A"	100	225—230	..	5 0 0
				WATER COMPANIES.				
743,052	Stck.	1 July	10	Chelsea, Ordinary	100	248–253*	..	3 19 1
1,720,252	Stck.	13 Apr.	8	East London, Ordinary	100	195—200	..	4 0 0
544,440	,,	1 July	4½	Do. 4½ p. c. Deb. Stk.	100	137–140*	+2	3 4 3
700,000	50	1 July	8½†	Grand Junction	50	99–103*	..	4 2 6
708,000	Stck.	12 Feb.	10½	Kent	100	260—265	..	3 19 3
1,043,800	100	1 July	9½	Lambeth, 10 p. c. max.	100	223–228*	+¾	4 3 4
406,800	100	,,	7½	Do. 7½ p. c. max.	100	191–196*	+¾	3 16 7
279,700	Stck.	30 Mar.	4	Do. 4 p. c. Deb. Stk.	100	122—125	..	3 4 0
500,000	100	12 Feb.	12½	New River, New Shares	100	325—335	..	3 22 4
1,000,000	Stck.	29 Jan.	4	Do. 4 p. c. Deb. Stk	100	127—130	..	3 1 6
902,300	Stck.	15 June	6½	S'thwk & V'xhall, 10 p. c. max.	100	147—152	..	4 5 6
126,500	100	,,	6½	Do. D 7½ p. c. do.	100	134—138	..	4 14 3
1,355,066	Stck.	15 June	10	West Middlesex	100	237–242	..	4 2 8

*Ex div.

† Next dividend will be at this rate.

Extensions and Improvements at the Leeds Water-Works.—The members of the Leeds Corporation Water Committee last Friday week inspected the works being carried out at Moortown, Blackmoor, and Eccup. They were accompanied by Mr. T. Hewson, the Borough Engineer, who explained the plans and operations at each place. At Moortown the old service reservoir is being greatly extended—that is to say, whereas the present capacity is 680,300 gallons, the addition being made will increase it to 1,360,000 gallons. The whole of the excavation for the new portion is completed; and the puddling and concreting are well advanced. The Committee having inspected the Moortown works, went to see the new Blackmoor Tunnel, which will be 2275 yards long. Some 1747 yards, with the requisite shafts, have been finished; and the shoring of the remainder having been completed, only 528 yards of brickwork has to be done. At Eccup reservoir a portion of the embankment is being reconstructed. The Committee descended to the bottom of the trench which has been excavated, and which is about 175 feet deep. Mr. Hewson stated that the stratum below, found by means of a trail hole, is in all respects sound and good. This being so, the re-filling of the trench will be proceeded with almost immediately.

The Sevenoaks Water Company's Provisional Order.—At a recent meeting of the Sevenoaks Local Board, the Committee who have had in hand the question of the purchase of the Water Company's works reported, in reference to the Provisional Order of the latter body, that, in presenting a memorial to the Board of Trade and subsequently a petition to the Committee of the House of Lords, they had kept in mind the chief object of the Local Authority—viz., to acquire the waterworks on fair and equitable terms on behalf of the ratepayers. Inasmuch as this feature of the case was not gone into by the Board of Trade, it was particularly pressed on the attention of the House of Lords, and with such evidence as appeared to the Committee overwhelmingly in favour of the water supply being in the hands of the Local Sanitary Authority. The Company having declined to sell by arbitration, and having moreover refused to allow the Board's Engineer to inspect their works, so that the Committee could make an offer for the property, their Lordships were asked to insert in the confirming Bill a clause for compulsory sale, which, however, they did not concede, but only cut down the new capital from £8000, as allowed by the Board of Trade, to £5000. The Committee suggested, and the Board agreed, that the best thing they could now do was "to await the issue of future events."

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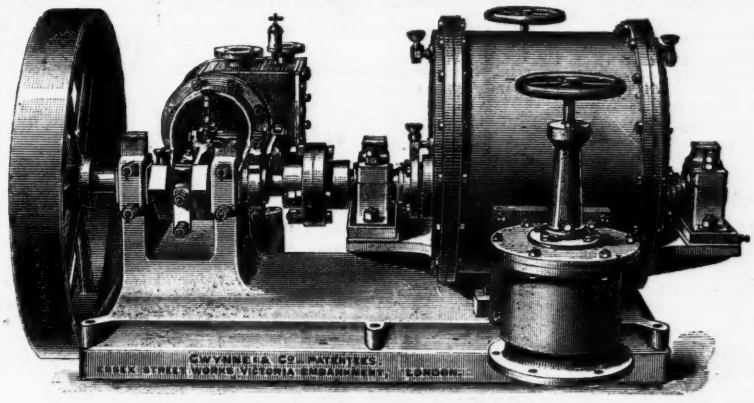

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O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

ANDREW STEPHENSON, Agent.
Please address all communications to the Company, as above.

ANDREW STEPHENSON, Agent for BRIN'S OXYGEN COMPANY, Limited, Westminster, S.W.
City Address: 182, Gresham House, Old Broad Street, LONDON, E.C.

WINKELMANN'S "Volcanic" Fire CEMENT. (Fire resistance, 4500° Fahr.)
Prices, particulars, and directions for use on application to ANDREW STEPHENSON, 182, Gresham House, Old Broad Street, LONDON, E.C.

CANNEL COAL, ETC.

JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, NEWTON GRANGE, NEAR DALKEITH, } SCOTLAND.

OXIDE OF IRON FOR GAS PURIFICATION.

JAMES GORDON & Co., Brokers, can offer Cargoes of good quality; also 2500 tons of SPENT OXIDE.
Samples and price on application.
Address Borough Buildings, 7, Rumford Street, LIVERPOOL.

JAMES LAWRIE & CO. supply Best SCOTCH CANNEL COALS, Best FIRE-CLAY RETORTS, BRICKS, TILES, and LUMPS; BOILER SEATING BLOCKS, FLUE COVERS, and SILICA BRICKS for SPECIAL FURNACE WORK; COKE BARROWS, BOGIES, and SMALL WAGONS.
Postal Address: 1, WHITTINGTON AVENUE, E.C.
Telegram Address: "EIRWAL LONDON."

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. III., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock, Oldham."

TUBES.

FOR Gas, Steam, and Water; Galvanized, White Enamelled, and Hydraulic Tubes, &c.
JOHN SPENCER, Globe Tube Works, WEDNESBURY, and 14, Great St. Thomas Apostle, LONDON.

HUTCHINSON BROTHERS, Barnsley, Gas Engineers and Contractors, Makers of Wet and Dry Gas-Meters and General Gas Apparatus, Sulphate of Ammonia Plant, Lead Saturators, Tanks, &c., Tools and Sundries.

JOHN RILEY & SONS, Chemical Manufacturers, Hapton, near Accrington, are MAKERS of SULPHURIC ACID, from Brimstone, for Sulphate of Ammonia making. Highest percentage of Sulphate of Ammonia obtained from the use of this Vitriol. References given to Gas Companies.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application.
OXIDE PAINT, SULPHURIC ACID, & Chemicals.
190 and 191, NEWGATE STREET, LONDON, E.C.

OLPHERT'S OXIDE.

FINEST Quality of Natural Bog Ore Apply for particulars to the Sole Agent, Mr. THOS. L. ARCHER, Cathedral Chambers, Half Street, MANCHESTER.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

OXIDE OF IRON. Genuine Natural Bog ORE. QUALITY AND CONDITION GUARANTEED. Any quantity supplied at lowest rates.
D. M. NELSON AND SONS, 68, Bath Street, GLASGOW. Telegraphic Address: "Gas, Glasgow." Depôts throughout England and Scotland.

COZE'S Automatic Apparatus for CHARGING AND DISCHARGING GAS-RETORTS. See Advertisement p. IV., centre of JOURNAL.
Inquiries should be addressed to THE AUTOMATIC COAL-GAS RETORT COMPANY, LIMITED, 86-88A, LEADENHALL STREET, E.C.

LIQUOR and Tar wanted.
BROTHERTON AND Co., Ammonia and Tar Distillers, LEEDS and WAKEFIELD.

RAILWAY TANKS for Hire. First-class condition.
BROTHERTON AND Co., LEEDS.

MESSRS. DEBENHAM, TEWSON, FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Waterside Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

ADVERTISER (age 27) seeks engagement as FITTER in a Gas-Works. A good Workman in Iron and Compo. Ten years' practical experience in Works. First-class References and Testimonials. Abstainer.
Address T., 8, Quay Road, Bridlington Quay, YORKS.

WANTED, by the Advertiser (age 29), a Situation as CLERK or SECRETARY to a Gas Company, or is open to accept an engagement as TRAVELLER. Nine years' experience on a Carbonizing Works. No objection to going abroad.
Address No. 2114, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Re-engagement as WORKING MANAGER or FOREMAN, practically experienced in Carbonizing, Engines and Exhausters, Fitting, Main and Service Laying, Index Reading, and the General Routine of Gas-Works. Unexceptionable references. Total abstainer.
Address No. 2112, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a situation as Manager or FOREMAN at a Gas-Works, where the annual make is from 5 to 10 million cubic feet. Advertiser has a thorough practical knowledge of the general routine of a Gas-Works, understands Steam and Gas Engine, laying Mains and Service-Pipes, fixing Meters, and is a good Fitter. Forty years of age, and has 17 years' good character. Satisfactory reasons given for leaving.
Apply to JOHN ROBERTS, Gas Manager, LLANGOLLEN.

WANTED, for the Haverhill Gas and Water Works, a PLUMBER and GAS-FITTER.
Apply, with testimonials, stating age and wages required, to Mr. B. GIBSON, Manager, Gas-Works, Haverhill, SUFFOLK.

WANTED, immediately, by the Llangollen Gas Company, Limited, a WORKING MANAGER. Must have a thorough practical knowledge of Gas Making and its Distribution. One who is also a Fitter preferred. Make of Gas, 3½ millions per year. House, Coal, and Gas free.
Applications, with testimonials, stating wages required, to be addressed to Mr. HARVEY BIRCH, Llangollen Gas Company, LLANGOLLEN.

MANAGER OF GAS-WORKS.

THE Corporation of Evesham will, on the 1st of December next, or earlier (if arranged), require a MANAGER for their Gas-Works. House, Fuel, and Light free. About 1700 tons of coal carbonized per annum. Population about 6000.
Applications, in own writing, stating salary required and age, and (fully and concisely) qualifications, with testimonials, and date (approximately) when duties could be entered upon, to be sent to me the undersigned on or before July 24.

THOS. COX,
Town Clerk.

Evesham,
June 29, 1892.

THE Newcastle and Gateshead Gas Company require an ASSISTANT MANAGER or GENERAL FOREMAN for their Gateshead Works, where the largest make is about 4 millions a day. He must be capable of taking the entire management of the Works in the absence of the Manager, and have a good general knowledge in all departments.
Applications, in own handwriting, with three recent testimonials of character and ability, and stating age, where now employed, when at liberty, and salary expected, to be addressed to the Chairman, Gas Office, Newcastle-on-Tyne, not later than the 1st day of August.

W. HARDIE,
Secretary.

June 27, 1892.

DEVONPORT WATER-WORKS.

WANTED, a competent Man as Foreman and CHIEF FITTINGS INSPECTOR, with practical knowledge of Pipe Laying, Plumbing, and Works generally. He must have had experience in supervision and control of workmen, and be competent to take readings of Meters, and to act as Storekeeper.
A person who has served his time as a Plumber preferred.
Wages, £2 5s. per week, with Rooms at Office.
Applications, stating age and experience, with *copies* of not more than three testimonials, to be sent in not later than the 11th of July, addressed to

H. FRANCIS, Assoc.M.Inst.C.E.,
Engineer and Manager.

Water-Works Office, Devonport,
June 20, 1892.

GAS-METERS FOR SALE.

THE Royal Agricultural Hall Company, Limited, Islington, have FOR SALE one 500-LIGHT DRY METER, and one 200-LIGHT DRY METER, which until recently have been used at the Hall, and are in good working order.
Apply to R. VENNER, Secretary, Royal Agricultural Hall Company, Limited, ISLINGTON.

FOR SALE—450 £1 Shares (fully paid) in the Perth Gas Company, Limited, Western Australia, at 28s. per Share, *ex* 10 per cent. dividend for year ending May 30, 1892. Further particulars on application.
Address No. 2113, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 70, Wellington Street, GLASGOW; 58, Fountain Street, MANCHESTER; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors, for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."

TO INVENTORS AND OTHERS.

PATENTS for Inventions Secured and TRADE MARKS REGISTERED throughout the World. Advice on all matters connected with the above. Handbook gratis on application.
J. C. CHAPMAN, C.E., Chartered Patent Agent, 70, Chancery Lane, LONDON.

SULPHURIC ACID.

HUGH WALLACE & CO., Chemical Manufacturers (the old-established firm), supply the above, which is specially adapted for making White Sulphate of Ammonia. The latter purchased in any quantity at highest market prices, or contracts for the year.
For prices and terms apply Botolph House, Eastcheap, LONDON, EC.

FOR SALE—Patent Self-Sealing Retort MOUTHPIECES (seven 16-inch Circular, and two Ovals, 22 in. by 15 in. and 21 in. by 15 in.), taken out for larger size. Guaranteed in good condition, and equal to new. Will be sold cheap.
Apply to JOHN A. HARRIS, Manager, Gas-Works, GREAT WIGSTON.

FOR SALE, cheap—Two Gasholders 35 ft. diameter by 12 ft. deep. Capacity, 11,500 cubic feet each. Also various other larger sizes.
WASHERS, from 500,000 to 250,000 feet per diem.
CONDENSERS, from 500,000 to 10,000 feet per diem.
EXHAUSTERS, from 120,000 to 5000 feet per hour.
STATION METERS, from 100,000 to 1500 ft. per hour.
Would erect any of the above, and make practically equal to new.
Inquiries invited for any second-hand Gas Plant.
Apply to SAML. WHILE (late Ashmore and While), 60, Queen Victoria Street, LONDON, E.C.

PONTYPOOL GAS AND WATER COMPANY.

CONSTRUCTION OF NEW WORKS, ETC.

AUTHORIZED CAPITAL	**£100,000**
ISSUED AND FULLY PAID-UP CAPITAL—	
A Shares and Stock	**£26,400**
B Shares	**10,000**
4 per cent. Debentures	**7,500**
	£43,900

Issue of 1500 New "C" Shares of £10 each, to rank equally with the Ordinary "B" Shares of the Company, and *pari passu* (according to the respective Maximum Dividends) with the Ordinary "A" Shares and Stock—payable £1 per Share on application, and the balance on the 31st of August, 1892.

DIRECTORS.

CHARLES JAMES PARKES, Esq., J.P., Wentsland, Pontypool (*Chairman*).
EDWIN GROVE, Esq., J.P., Newport, Mon., Chairman Monmouthshire County Council (*Vice-Chairman*).
ALFRED ADDAMS WILLIAMS, Esq., J.P., Maesderwen, near Pontypool.
FREDERICK PHILLIPS, Esq., Green Lawn, near Pontypool.
THOMAS HEDGES DEAKIN, Esq., Parkend, Gloucestershire.
WILLIAM HENRY DAVIES, Esq., Glansychan, near Pontypool.

MANAGER.

LIEUT.-COL. ANDREW HAIR, Trosnant House, Pontyyool.

SECRETARY and OFFICES.

T. B. PEARSON, Trosnant, Pontypool.

TENDERS are invited for the purchase of the above in Lots of 10 Shares; but Applicants may Tender for any number of Lots.
The Shares are sold pursuant to the powers conferred on the Company by and subject to the provisions of the Pontypool Gas and Water Act, 1890, and the Acts incorporated therewith; and all Tenders will be deemed to be subject thereto, and to the terms herein contained.
The Maximum Dividend on the "A" Stock and shares is 10 per cent., and on the "B" (and "C" Shares now created) 7 per cent.; and, in case of any insufficiency in the net revenue to yield such percentages, a proportionate reduction will be made in the Dividend on each class of Shares.
The Company have paid 7½ per cent., free of Income-Tax, on the "A" Shares since 1874, and 5 per cent., free of Income-Tax, on the "B" Shares since the same were created in 1876.
The Shares will rank for Dividend as from the 1st day of September, 1892, provided the full purchase-money is paid as herein required.
Should no allotment be made, the deposit will be returned in full.
Forms of Tender may be obtained on application to the undersigned.
Sealed tenders, endorsed "Tender for Shares," to be sent to me not later than Friday, the 8th day of July, 1892.

By order,
T. B. PEARSON,
Secretary.

Trosnant, Pontypool,
June 7, 1892.

DRAWINGS, Tracings, Specifications, Quantities, &c., prepared by an experienced Engineering Draughtsman. Plans of Works made, copied, or enlarged. Blue copies made. Illuminated Addresses in first-class style. Writings of all kinds, Engrossments, &c.
Address J. L. FEATHERSTONE, 173, Fentiman Road, LONDON, S.W.

FRIEDRICH LUX, Ludwigshafen am Rhein; and at No. 142, Great Portland Street, London, W.
LUX's Gas Regulators for every consumption.
LUX's single-stem Pressure-Gauges.
LUX's Regulator for Gas-Engines.
LUX's Gas-Balance.
LUX's new Gas Regulator for Inverted Lamps and other Apparatus for Gas Lighting, &c.

CORPORATION OF MOSSLEY.
(GAS DEPARTMENT.)

THE Gas Committee are prepared to receive TENDERS for the supply of 7000 tons of COAL and 1000 tons of CANNEL.
Sealed tenders to be sent to the Town Clerk, endorsed "Gas Coal," not later than Noon on the 11th of July.
Particulars and Form of Tender may be obtained on application to the Manager (Mr. Richard Merrell).
The Committee do not bind themselves to accept the lowest or any tender.

By order,
JOSEPH HYDE,
Town Clerk.

Mossley, June 11, 1892.

CITY OF BELFAST.

CONTRACT FOR COAL.

THE Gas Committee of the Belfast Corporation invite TENDERS for a supply of 110,000 tons of best screened GAS COAL, to be delivered free and trimmed in Barges at Belfast Harbour, between Sept. 1, 1892, and Aug. 31, 1893.
No tender for less than 10,000 tons will be considered.
Monthly quantities and particulars may be obtained from the Manager of the Gas-Works.
Tenders, on Office Forms, endorsed "Tender for Coal," should be delivered at my Office not later than the 20th of July.
The lowest or any tender not necessarily accepted.

SAMUEL BLACK,
Town Clerk.

BOROUGH OF NELSON.
(GAS DEPARTMENT.)

THE Gas Committee of the above Corporation invite TENDERS for the supply and erection of four 12 feet square PURIFIER COVERS and INLET and OUTLET PIPES, 3 ft. 3 in. diameter, for new Gasholder.
Plans and Specifications can be seen at the Office of the Engineer, Mr. W. Foster, Gas-Works, Nelson.
Form of Tender may be obtained from the Engineer, on deposit of One Guinea, which will be returned on receipt of *bonâ fide* tender.
Sealed tenders, endorsed "Purifier Covers and Pipes," and addressed to Mr. R. M. Prescott, Town Hall, Nelson, to be sent in on or before Monday, the 18th day of July, 1892.
The Committee do not bind themselves to accept the lowest or any tender.

By order,
R. M. PRESCOTT,
Town Clerk.

Town Hall, Nelson,
July 2, 1892.

SMETHWICK LOCAL BOARD OF HEALTH.

GAS COAL.

THE Gas Committee are prepared to receive TENDERS for the supply of about 15,000 tons of GAS COAL for delivery during the year ending the 31st of July, 1893, in such quantities and at such times as may be required, carriage free, either at the Soho Station of the London and North-Western Railway, or the Handsworth Station of the Great Western Railway, as the Committee may determine.
Forms of Tender and further Information may be obtained from Mr. B. W. Smith, at the Gas-Works.
Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Gas Coal," to be delivered to the undersigned not later than the 28th of July inst.
The Committee do not bind themselves to accept the lowest or any tender.

By order,
W. J. STURGES,
Secretary.

Public Buildings, Smethwick,
July 2, 1892.

TENDERS FOR GAS COAL.

THE Gas Committee of the Newry Town Commissioners invite TENDERS for the supply of from 3000 to 3600 tons of GAS COAL, to be delivered in such quantities as may be required by the Committee, and delivered free *ex* Ship or Steamer at Albert Basin, Newry.
The Coal to be fresh wrought, dry, and free from Clench, Pyrites, or other objectionable matter for Gas Making.
The Committee would assist the Contractor by allowing him to deliver about 1500 tons of Coal prior to the middle of October next.
Further particulars may be obtained from Mr. A. Gibb, Manager.
Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal and where raised, to be addressed to the Chairman, Gas Office, Kilmorey Street, Newry, and delivered not later than Thursday evening, the 7th of July next.
The Committee reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.

By order,
JOHN KERNAGHAN, Secretary.

Gas Offices, Newry,
June 24, 1892.

TENDERS FOR COAL.

THE Directors of the Isle of Thanet Gas Company invite TENDERS for the supply of 14,000 tons of the best NEWCASTLE GAS COAL, to be delivered either into their Lift-Waggon on the Company's Premises, or f.o.b. Vessels in the Tyne.

The Directors do not bind themselves to accept the lowest or any tender.

Tenders to be sent in on or before Thursday, July 28, addressed to the Chairman of the Company.

Full Particulars and Forms of Tender may be had on application.

THOS. C. FULLER,
Secretary.

Gas-Works, Margate,
July 1, 1892.

TENDERS FOR FREIGHT.

THE Directors of the Isle of Thanet Gas Company invite TENDERS for the FREIGHT and CARTAGE of 14,000 tons of COAL from the Tyne to the Margate Gas-Works.

The Directors do not bind themselves to accept the lowest or any Tender.

Tenders to be sent in on or before July 28, addressed to the Chairman of the Company.

Full particulars may be had on application.

THOS. C. FULLER,
Secretary.

Gas-Works, Margate,
July 1, 1892.

HUYTON AND ROBY GAS COMPANY.

TENDERS FOR COAL AND CANNEL.

THE Directors of this Company invite TENDERS for the supply of about 1500 tons of best screened GAS NUTS or GAS COAL and 500 tons of best screened CANNEL or CANNEL NUTS, to be delivered during the year ending the 30th of June, 1893, in the Gas-Works Siding, Huyton Quarry, in such quantities as may be required by the Company.

The material to be clean, dry, and fresh worked.

The Company will provide their own waggons for transit of the greater portion of the materials.

Tenders, sealed and endorsed "Gas Coals," specifying the description of the Coals and name of the Pit from which the Coals are to be supplied, may be sent in to me not later than Saturday, the 9th prox.

FRED. PRITCHARD,
Secretary and Manager.

Huyton Quarry,
June 28, 1892.

CLITHEROE CORPORATION GAS-WORKS.

THE Corporation of Clitheroe invite TENDERS for not exceeding 3000 tons of screened or unscreened GAS COALS, and about 200 tons of CANNEL, to be delivered at the Gas-Works, Clitheroe, during a period of Twelve months from the 30th of September next, in such quantities as may be required.

Forms of Tender (upon which only tenders will be received) and further Particulars may be obtained on application to Mr. Miles, Manager, Gas-Works, Clitheroe.

Tenders to be sent to me on or before the 28th of July next.

The Corporation do not bind themselves to accept the lowest or any tender.

JOHN EASTHAM,
Town Clerk.

Clitheroe, June 25, 1892.

STRATFORD-UPON-AVON CORPORATION.
(GAS DEPARTMENT.)

TENDERS FOR GAS COAL.

THE Gas Committee invite Tenders for the supply of GAS COAL or NUTS of best quality, as may be required during the Twelve Months ending June 30, 1893; the whole of the quantity required being about 3500 tons, the same to be delivered free upon their Siding of the Great Western Railway Company.

The Committee do not bind themselves to accept the lowest or any tender.

Forms of Tender and any further information may be obtained of

J. S. CRANMER,
Secretary and Manager.

Corporation Gas-Works,
Stratford-upon-Avon, June, 1892.

COUNTY BOROUGH OF HUDDERSFIELD.
(GAS DEPARTMENT.)

COAL AND CANNEL CONTRACTS.

THE Gas Committee of the Huddersfield Corporation are prepared to receive TENDERS for the supply of GAS COAL and CANNEL, for a period of about Twelve months, commencing August next.

Probable quantities required:
30,000 tons of Cannel.
20,000 tons of Coal.

Full Particulars and Form of Tender may be had on application to Mr. W. R. Herring, Engineer, Gas-Works, Huddersfield, to whom tenders must be addressed, and delivered on or before Monday, the 11th of July, endorsed "Tender for Coal."

By order,
H. BARBER, Town Clerk.

Huddersfield, June 28, 1892.

TENDERS FOR GASHOLDER.

THE Directors of the Rochester, Chatham, and Strood Gaslight Company invite TENDERS for the Construction and Erection of a TELESCOPIC GASHOLDER, with a Wrought-Iron GUIDE-FRAMING.

Plans can be seen, and Copies of Specification had, after the 27th of June, on application at the Offices of the Company, 58, High Street, Rochester.

Tenders, marked "Tender for Gasholder," to be delivered at the Offices as above before Noon of Thursday, the 28th of July, 1892.

The Directors will not be bound to accept the lowest or any tender.

WILLIAM SYMS, Secretary.

June 16, 1892.

OLDBURY LOCAL BOARD OF HEALTH.
(GAS DEPARTMENT.)

TENDERS FOR COAL, ETC.

THE Gas Committee are desirous of receiving TENDERS for the supply of 6000 tons of GAS COAL for delivery to the Oldbury Basin of the Great Western Railway Company, over Twelve months, from the 1st of August, 1892.

Also for 1000 tons of CANNOCK FIRING SLACK, to be delivered to the Canal Wharf of the Board in Boats, over a similar period.

Tenders, which must be endorsed "Coal" or "Slack Tender," as the case may be, must reach me not later than Wednesday morning, the 13th of July, 1892.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
C. MEIKLEJOHN,
Engineer and Manager.

June 26, 1892.

MILFORD IMPROVEMENT ACT, 1857.

TENDERS FOR GAS AND STEAM COAL.

THE Milford Improvement Commissioners are prepared to receive TENDERS for about 700 tons of large through and small GAS COAL, and about 150 tons of good BITUMINOUS STEAM COAL, to be delivered between the 1st of August, 1892, and the 1st of August, 1893. The whole of the Coal to be fresh hewn, clean, and free from impurities.

Further Particulars and Forms of Tender can be obtained on application to the undersigned.

Sealed tenders, endorsed "Tender for Coal," addressed to the Chairman, Gas and Water Committee, to be sent in not later than the 11th of July next.

The Board do not bind themselves to accept the lowest or any tender.

By order,
THOMAS H. LEWIS,
Clerk.

Milford Haven,
June 21, 1892.

GASHOLDERS

C. & W. WALKER

Are now erecting a four-lift Holder of about 8 MILLION cubic feet,

at the Beckton Gas-Works, London.

PURIFIERS;

PURIFYING MACHINES;

CO_2 AND TAR-EXTRACTING WASHERS; SCRUBBERS;

SULPHATE & SULPHUR PLANT;

PATENT SELF-SEALING RETORT MOUTHPIECES;

LIFTING APPARATUS; CENTRE AND FOUR-WAY VALVES;

SOLE MANUFACTURERS OF WECK'S PATENT CENTRE-VALVE;

PATENT TAR PLANT; CONDENSERS;

SLIDE VALVES; TAR BURNERS; &C., &C.

WOOD SIEVES.

ADDRESSES:

MIDLAND IRON-WORKS, DONNINGTON, NEAR NEWPORT, SHROPSHIRE;

10, Finsbury Square, London.

"FORTRESS DONNINGTON." "FORTRESS LONDON."—Telegraphic."

GAS COAL.

THE Directors of the Oakham Gas Company, Limited, invite TENDERS for about 750 tons of good GAS COAL or NUTS.

For particulars apply to

JAS. MASON,
Manager.

BRIDGNORTH CORPORATION GAS-WORKS.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee hereby invite sealed TENDERS for the supply of GAS COAL, including Carriage to the Bridgnorth Railway Station, as follows:—

(1) For One, Two, or Three years, determinable at the option of the Gas Committee at the end of the first or second year.

(2) For One year only.

Evidence as to the quality of the Coal must accompany each tender.

Quantity required, about 1600 tons per annum, in proportionate deliveries as directed.

The contract to commence at the end of August.

Sealed and marked tenders must be sent to the undersigned not later than Saturday, the 9th of July.

The Committee do not bind themselves to accept the lowest or any tender.

J. H. COOKSEY, Town Clerk,
Secretary.

Bridgnorth,
June 23, 1892.

GLOUCESTER GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of 20,000 tons of GAS COAL for One year, from the 1st day of August next, in such monthly quantities as may be required by the Company.

Tenders to state the price delivered at the Midland Railway Wharf, High Orchard, or the Great Western Railway Wharf, Llanthony, Gloucester; or, if sent (as preferred) by Water, the price delivered both in Vessel and at the Gas Company's Wharf, on the Gloucester and Berkeley Canal.

Forms of Tender may be obtained of the undersigned.

Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman, Gas Offices, Eastgate Street, Gloucester, and delivered not later than Monday, the 11th day of July next.

The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.

By order,
WILLIAM E. VINSON,
Secretary.

Gas Offices, Gloucester,
June 9, 1892.

DENTON AND HAUGHTON LOCAL BOARD.
(GAS DEPARTMENT.)

COAL AND TAR.

THE Committee invite Tenders, on or before July 13, 1892, for COAL; also for the TAR to be produced at their Works for a period of Twelve months.

Particulars and Forms of Tender may be obtained from Mr. J. M. Veevers, Gas-Works, Denton, near Manchester.

By order,
JOHN RICHARDS,
Clerk to the Board.

Denton,
June 20, 1892.

BOLTON CORPORATION.
(GAS DEPARTMENT.)

THE Gas and Lighting Committee are prepared to receive TENDERS for the supply of best screened GAS COAL, COBBLES, and NUTS, and screened CANNEL, to be delivered between the 15th of August, 1892, and the 30th of June, 1893.

Tenders, addressed to Mr. Alderman Miles, Chairman of the Gas and Lighting Committee, Gas Offices, Bolton, and endorsed "Tender for Gas Coal, &c.," to be delivered on or before the 13th of July, 1892.

Specification, with quantities, Form of Tender, and further information, may be obtained from Mr. W. Walch, Gas Offices, Bolton.

R. G. HINNELL,
Town Clerk.

Town Hall, Bolton,
June 22, 1892.

SEVENOAKS GAS COMPANY.

TO COLLIERY PROPRIETORS AND AGENTS.

THE Directors of the Sevenoaks Gas Company are desirous of receiving TENDERS for the supply of 5000 tons of GAS COAL, to be delivered during Nine months from July, 1892, to April, 1893, at the Bat and Ball Station (L.C. & D.R.), Sevenoaks.

The districts preferred are Durham, Newcastle, and Yorkshire; and two-thirds of the total quantity will have to be delivered by Jan. 31, 1893, and the remainder by the beginning of April, 1893.

The Directors reserve to themselves the right of dividing the Contract among two or more firms, and are not bound to accept the lowest or any tender.

Forms of Tender may be obtained on application to the Secretary; and the tenders must reach the Company's Office not later than Tuesday, the 12th day of July next, endorsed "Tender for Gas Coal," and addressed to the Chairman, William Hughes, Esq., 88, High Street, Sevenoaks.

By order,
HENRY HOW, Secretary.

Gas Office, Sevenoaks,
June 25, 1892.

CHIPPING NORTON GAS COMPANY, LIMITED.

TENDERS are invited for the supply and delivery at Chipping Norton of from 250 tons to 900 tons of good screened GAS COAL or NUTS, in such quantities and at such times as the undersigned may direct.

Tenders to be addressed to THOS. BURTONSHAW, Manager.

OSWALDTWISTLE LOCAL BOARD.

THE Gas Committee invite Tenders for the TAR and LIQUOR produced at their Works for One year from the 31st day of July, 1892.

The quantity of Coal carbonized is over 3500 tons.

Further particulars may be obtained from the Manager, Gas-Works, Church, near Accrington.

Endorsed tenders to be addressed to me and to be delivered not later than Wednesday, the 13th of July.

WM. SANDEMAN,
Clerk.

Local Board Offices, Oswaldtwistle,
June 17, 1892.

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BY

F. SOUTHWELL CRIPPS, Assoc. M. Inst.C.E.

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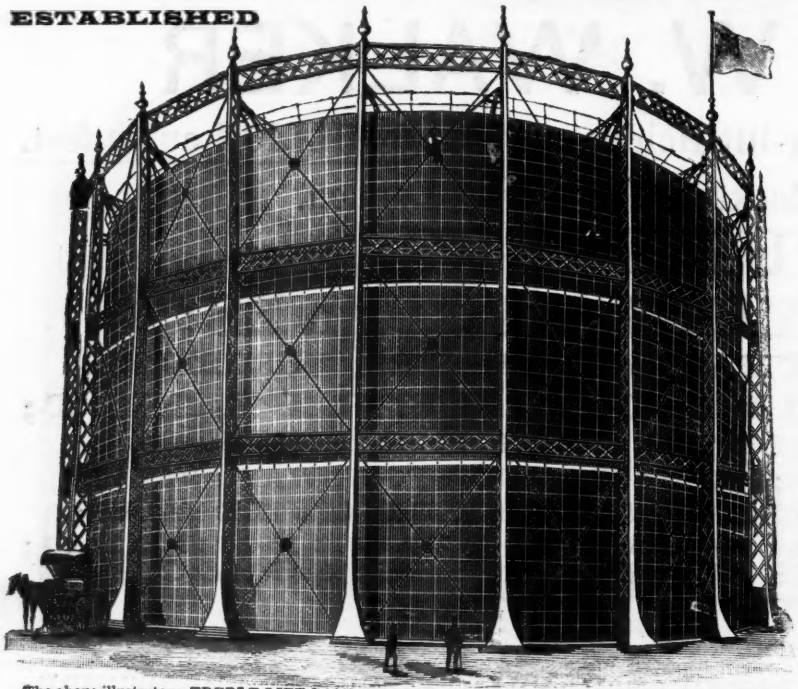

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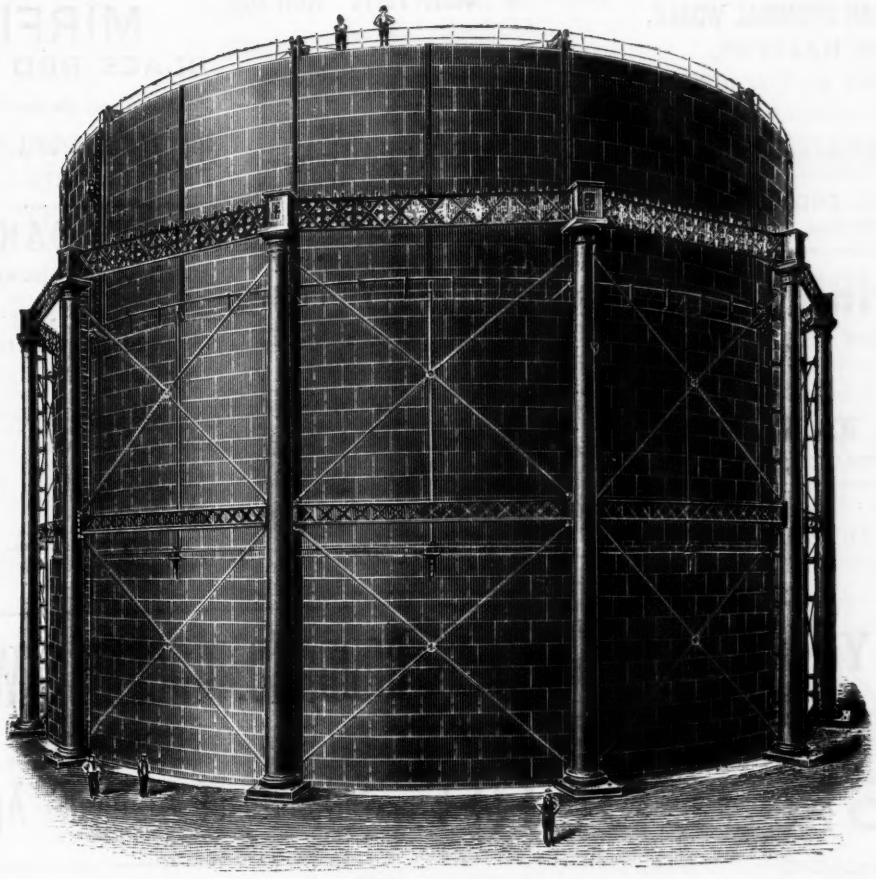

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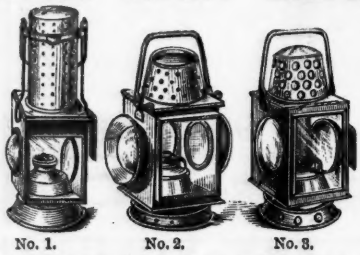

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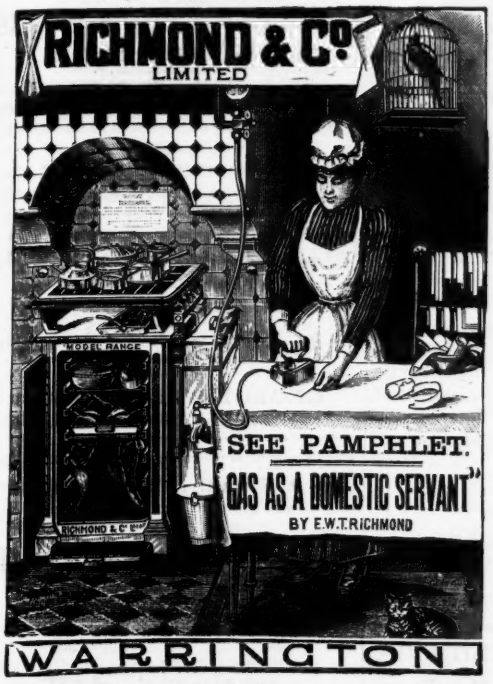

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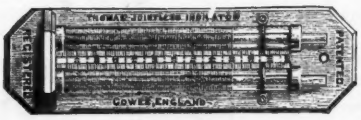

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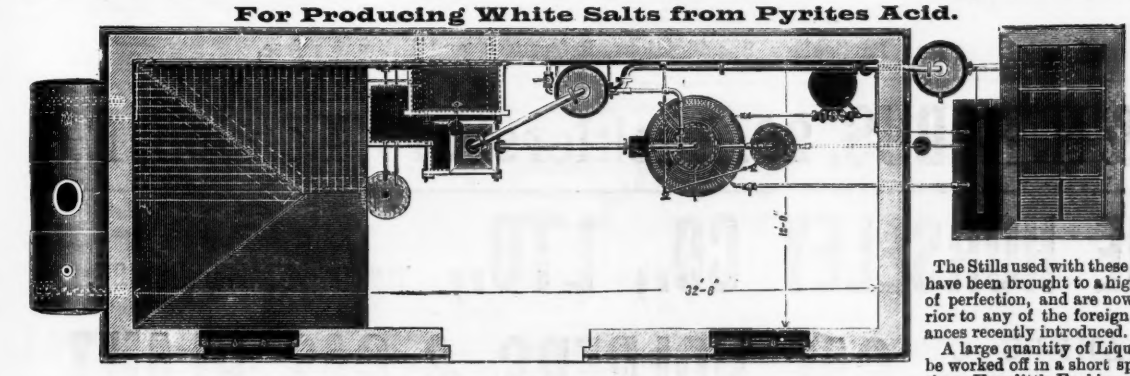

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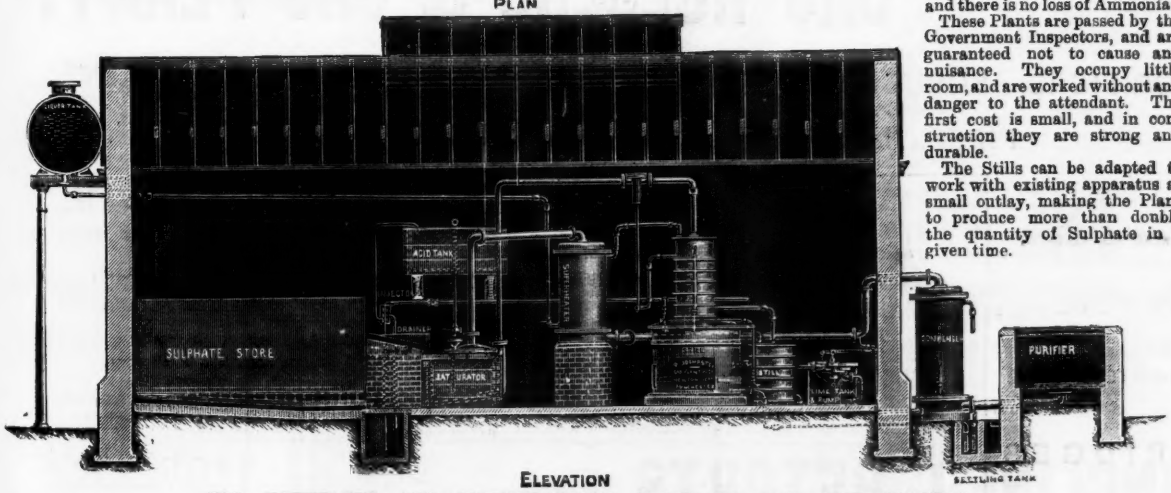

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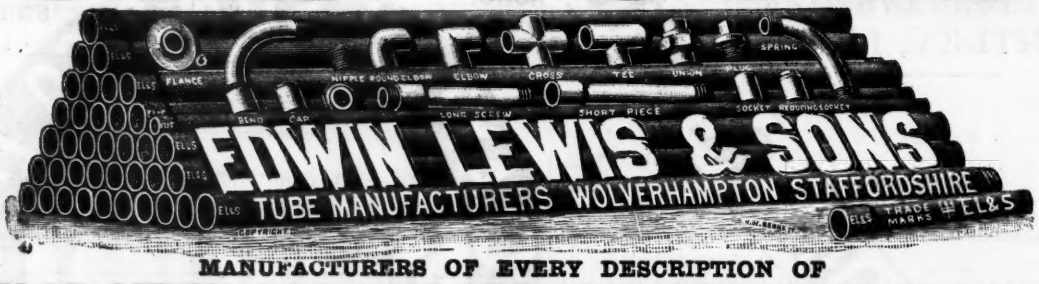

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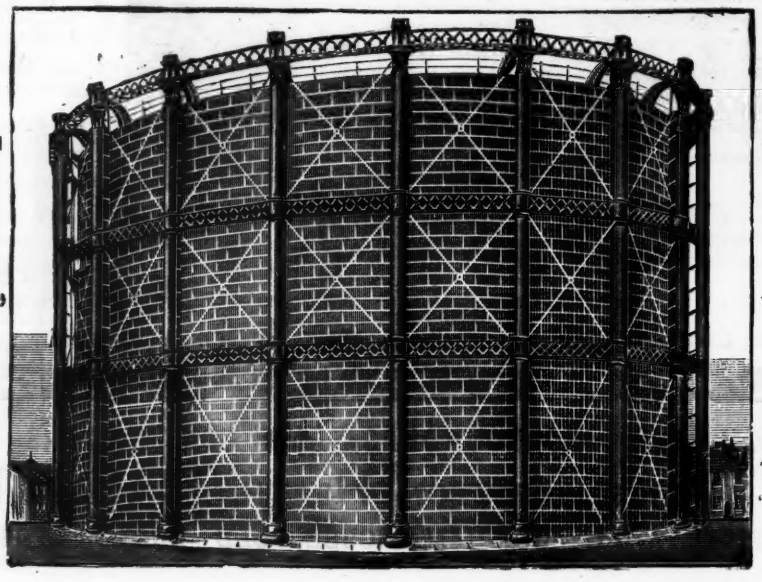

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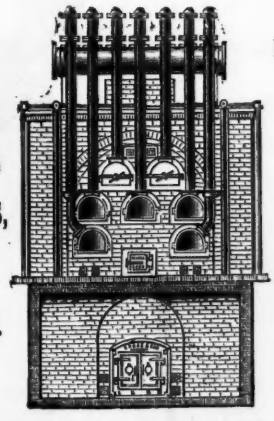

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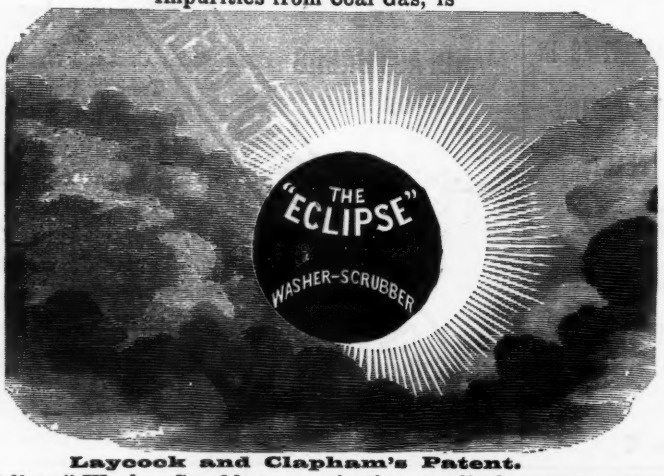

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